5.9 ELECTRICAL MODULE OFF-LINE DIAGNOSTICS

5.9.1 OFF-LINE DIAGNOSTIC TESTS

The Off-Line Diagnostic Tests are embedded in the software. When the Diagnostic Mode has been invoked, the user can sequence through a series of 18 tests, using the ↑ and ↓ keys, and view the results on the Front Panel.

NOTE: *The number corresponding to the active diagnostic test will always appear on the Set Temperature Display, with the exception of Test #3.*

The individual test functions are described in Paragraphs 5.9.2 thru 5.9.19.

ENTRY

To access the Off-Line Diagnostic Mode, turn the ac power *On* and simultaneously depress the ↑ and ↓ keys.

NOTE: *Both keys must be held until the initial phase of the self-test is complete.*

When the Diagnostic Mode is successfully accessed, the front panel LED's will change to a special default pattern (refer to Figure 5.1). Once this pattern appears, release the ↑ and ↓ keys for the remaining phases of the self-test.

When all phases of the self-test are complete, '1' will appear in the Set Temperature Display, indicating to the user that the first test is active.

EXIT

The Off-Line Diagnostic mode can be terminated by turning *Off* and then *On* (power cycling) the **Resuscitaire® Radiant Warmer.**

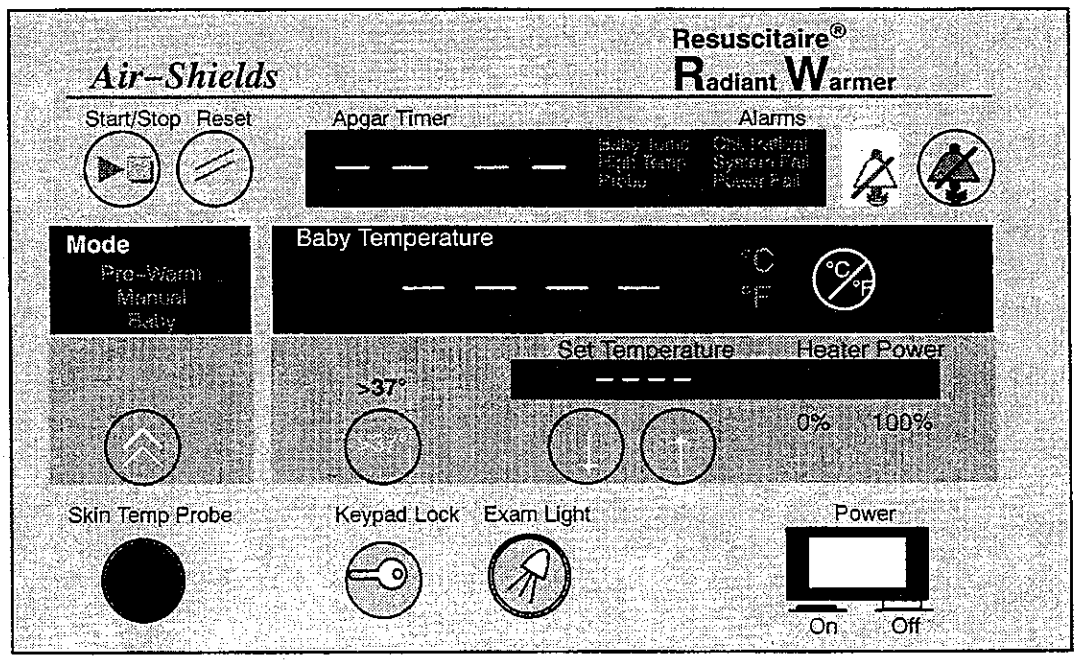
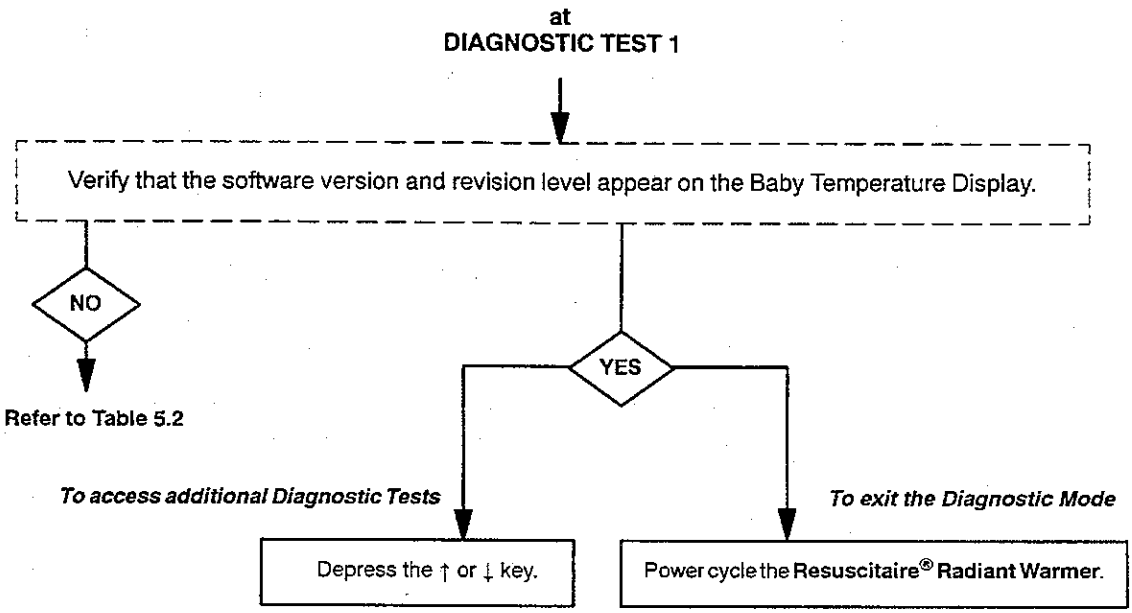


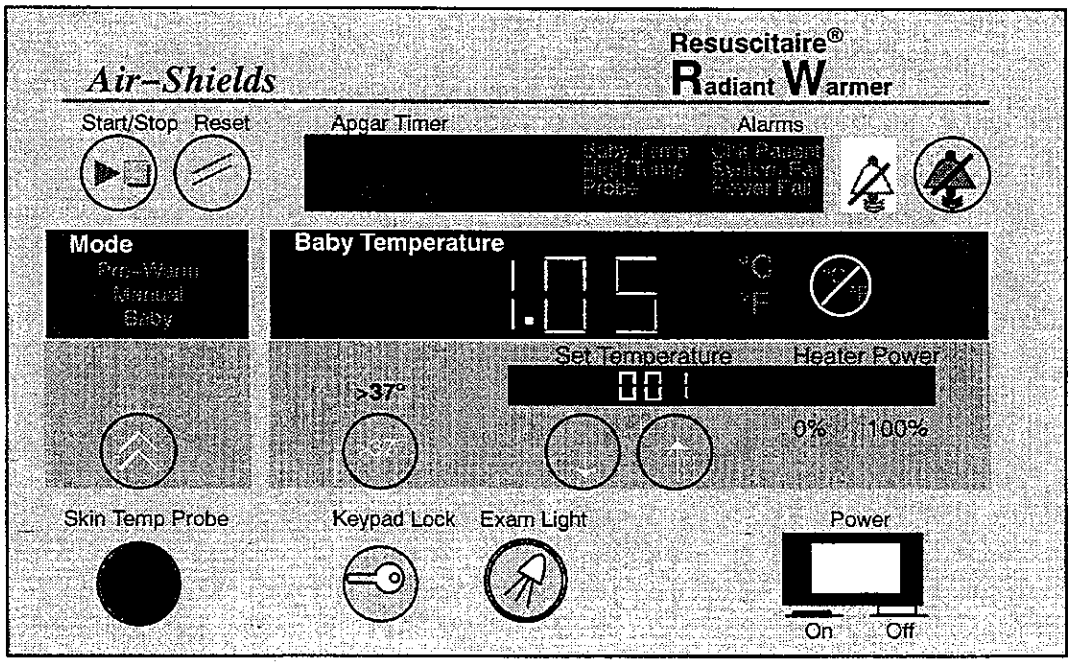
FIGURE 5.1: DIAGNOSTIC MODE START-UP DISPLAY

5.9.2 DIAGNOSTIC TEST 1 – Software Level Display

This test displays the version and revision level of the **Resuscitaire® Radiant Warmer** software.

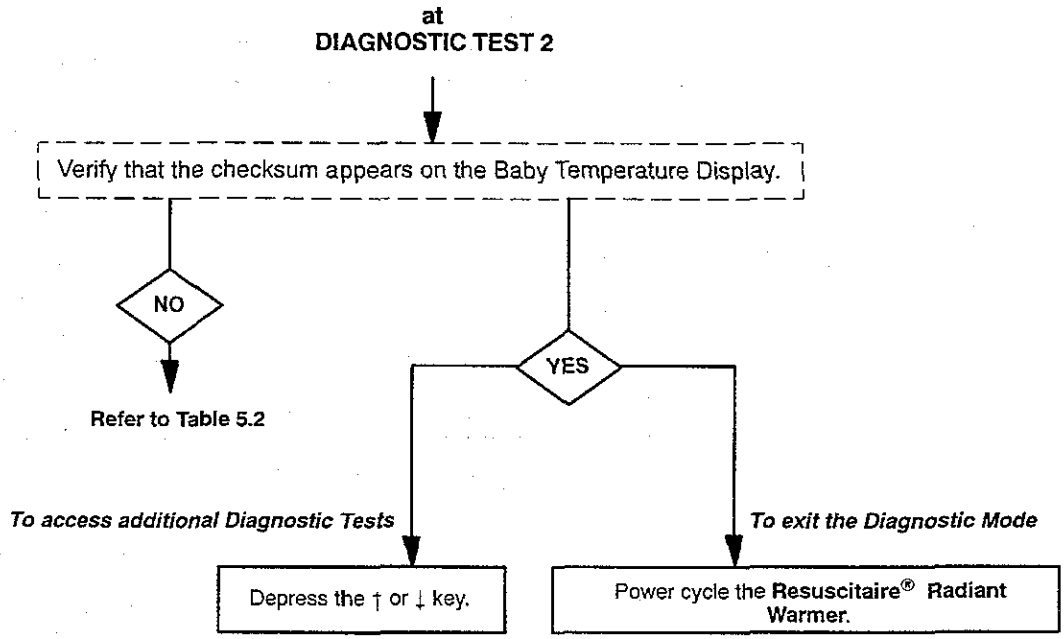

at
DIAGNOSTIC TEST 1
Verify that the software version and revision level appear on the Baby Temperature Display.
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
Depress the ↑ or ↓ key.
To exit the Diagnostic Mode
Power cycle the Resuscitaire® Radiant Warmer.

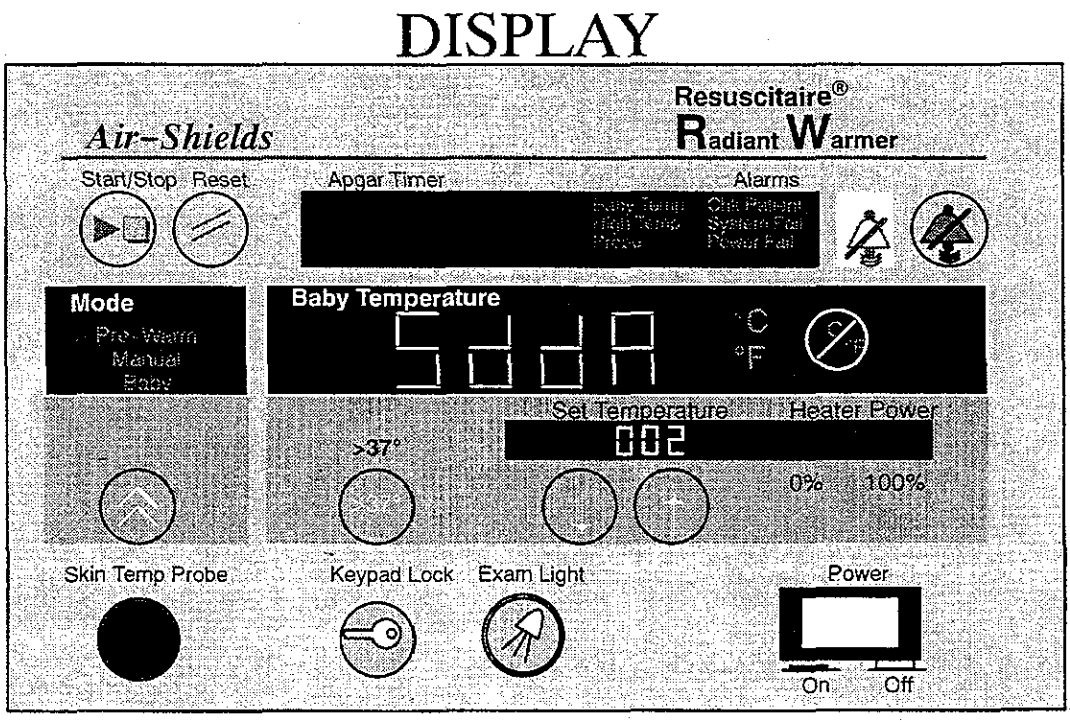
DISPLAY



5.9.3 DIAGNOSTIC TEST 2 – ROM Device Checksum Display

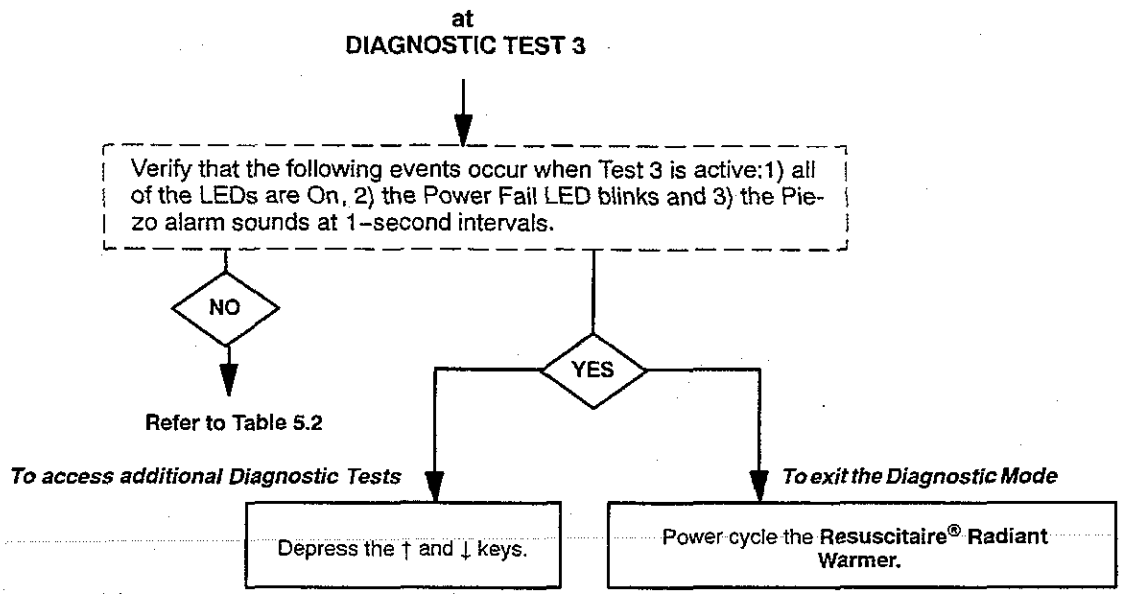
This test displays the ROM Device Checksum. The checksum is shown as a hexadecimal number on the Baby Temperature Display. It is identical with the four digits reported by the DATA I/O programmer during a verify or copy operation and is also printed on the ROM label.

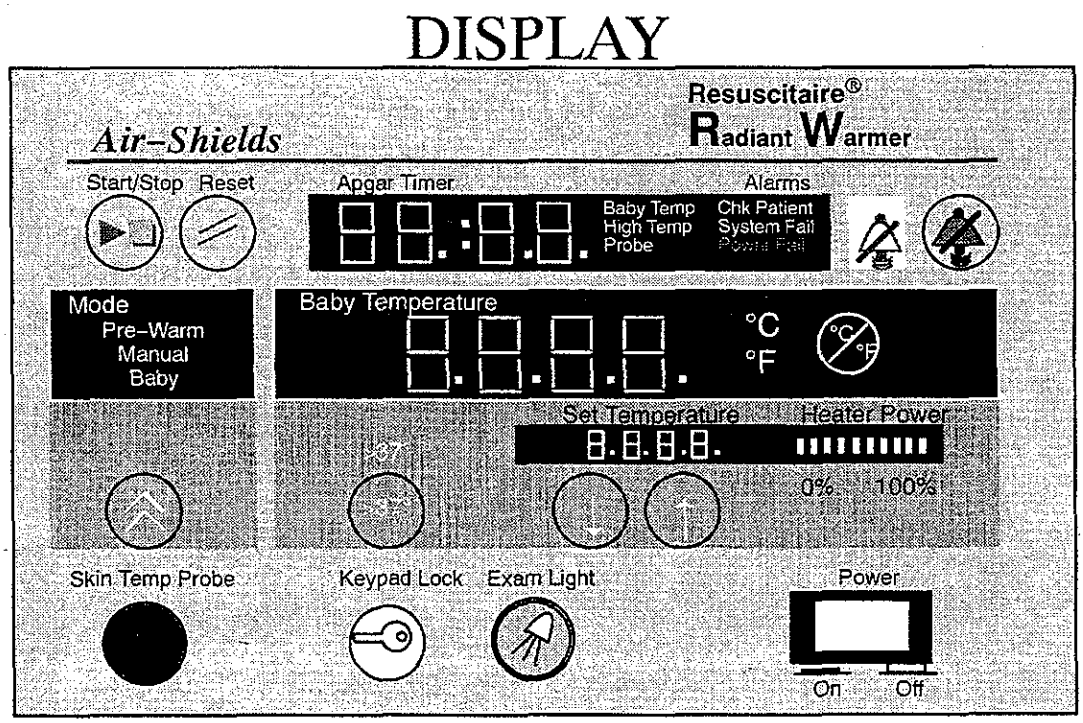

at
DIAGNOSTIC TEST 2
Verify that the checksum appears on the Baby Temperature Display.
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
Depress the ↑ or ↓ key.
To exit the Diagnostic Mode
Power cycle the Resuscitaire® Radiant Warmer.



5.9.4 DIAGNOSTIC TEST 3 – Power Fail Test

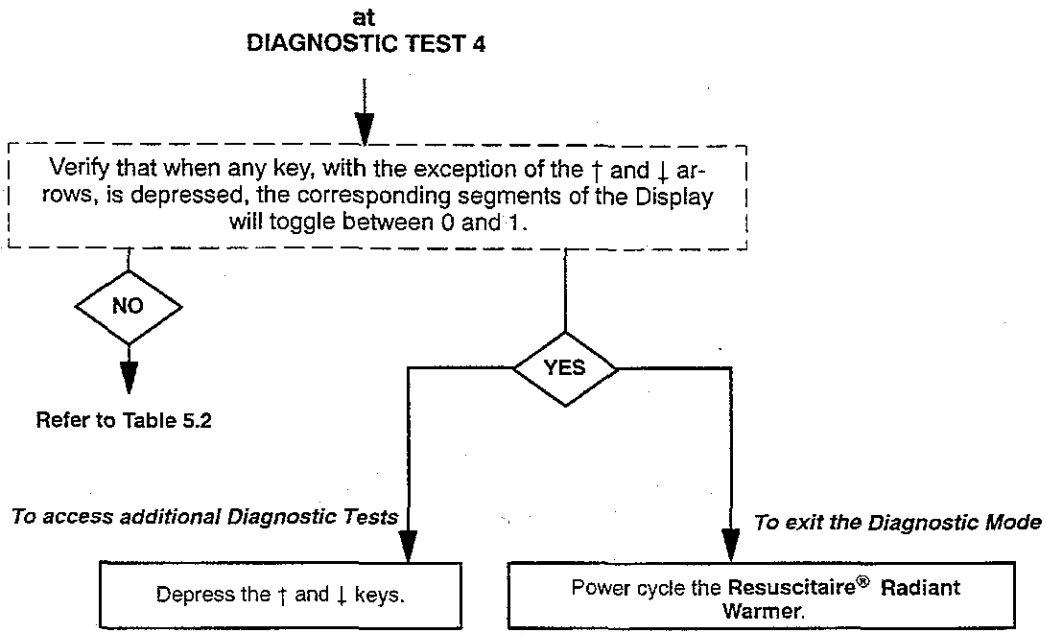
This test verifies the operation of the Power Fail Circuit. When this test is activated, all of the LEDs are *On* and the Power Fail LED blinks. The Piezo alarm sounds at 1–second intervals.

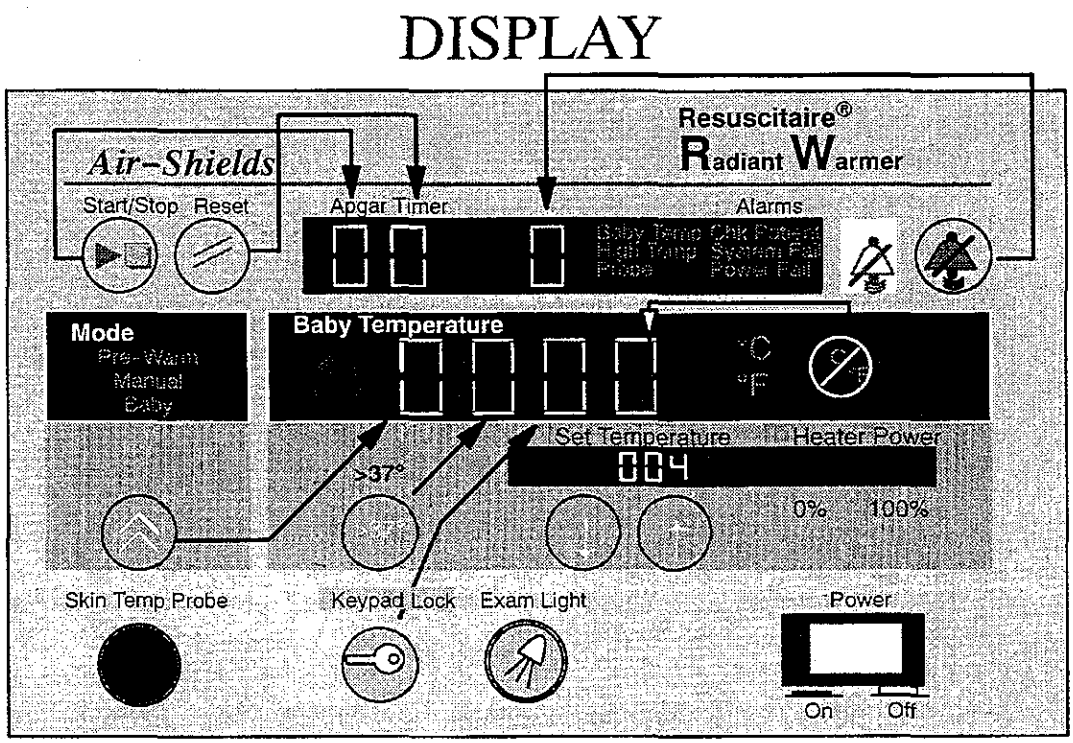

at
DIAGNOSTIC TEST 3
Verify that the following events occur when Test 3 is active:1) all of the LEDs are On, 2) the Power Fail LED blinks and 3) the Piezo alarm sounds at 1–second intervals.
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
Depress the ↑ and ↓ keys.
To exit the Diagnostic Mode
Power cycle the Resuscitaire® Radiant Warmer.



5.9.5 DIAGNOSTIC TEST 4 – Key Check

This test checks for keypad failures. In order to prove the operation of the keys, a total of seven zeros *(0)* will be shown in the APGAR and BABY TEMP Displays. Pressing any of the keys on the Front Panel will momentarily cause the nearest *0* to change to a *1*.


at
DIAGNOSTIC TEST 4
Verify that when any key, with the exception of the ↑ and ↓ arrows, is depressed, the corresponding segments of the Display will toggle between 0 and 1.
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
Depress the ↑ and ↓ keys.
To exit the Diagnostic Mode
Power cycle the Resuscitaire® Radiant Warmer.



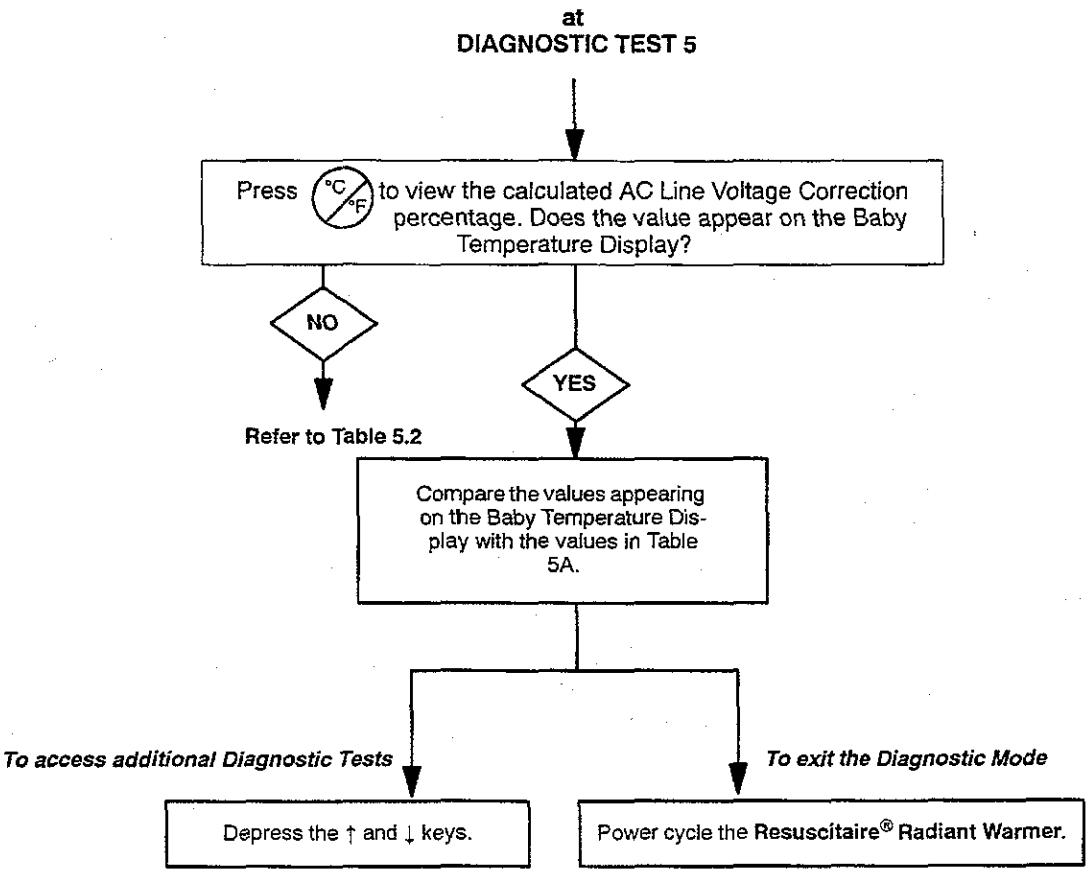
5.9.6 DIAGNOSTIC TEST 5 – Heater Duty Cycle Test

This test displays the current ac heater duty cycle percentage applied to achieve 600 Watts of power in the power range listed below:

90 Vac to 110 Vac (100 V Heater)
100 Vac to 135 Vac (120 V Heater)
190 Vac to 235 Vac (220 V Heater)

After pressing °C/°F, the AC Line Voltage Correction percentage will appear on the Baby Temperature Display. A list of values is given in Table 5.A.

NOTE: *In order to verify the AC Line Voltage, perform Diagnostic Test 6 prior to performing this test.*


at
DIAGNOSTIC TEST 5
Press °C/°F to view the calculated AC Line Voltage Correction percentage. Does the value appear on the Baby Temperature Display?
NO
YES
Refer to Table 5.2
Compare the values appearing on the Baby Temperature Display with the values in Table 5A.
To access additional Diagnostic Tests
To exit the Diagnostic Mode
Depress the ↑ and ↓ keys.
Power cycle the Resuscitaire® Radiant Warmer.

DISPLAY

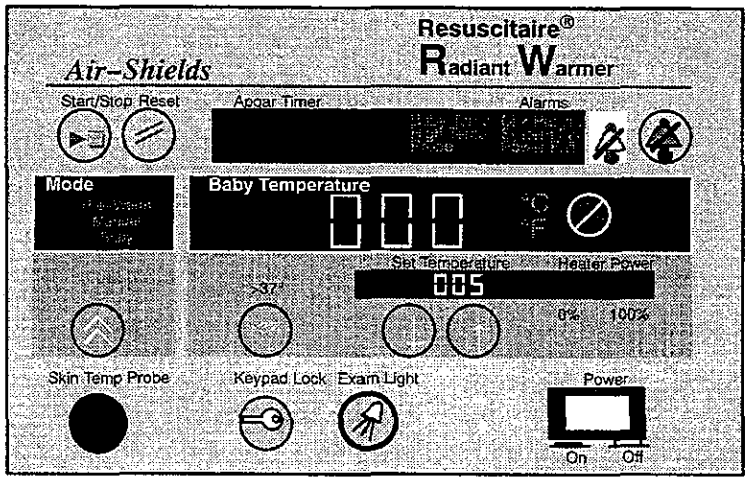
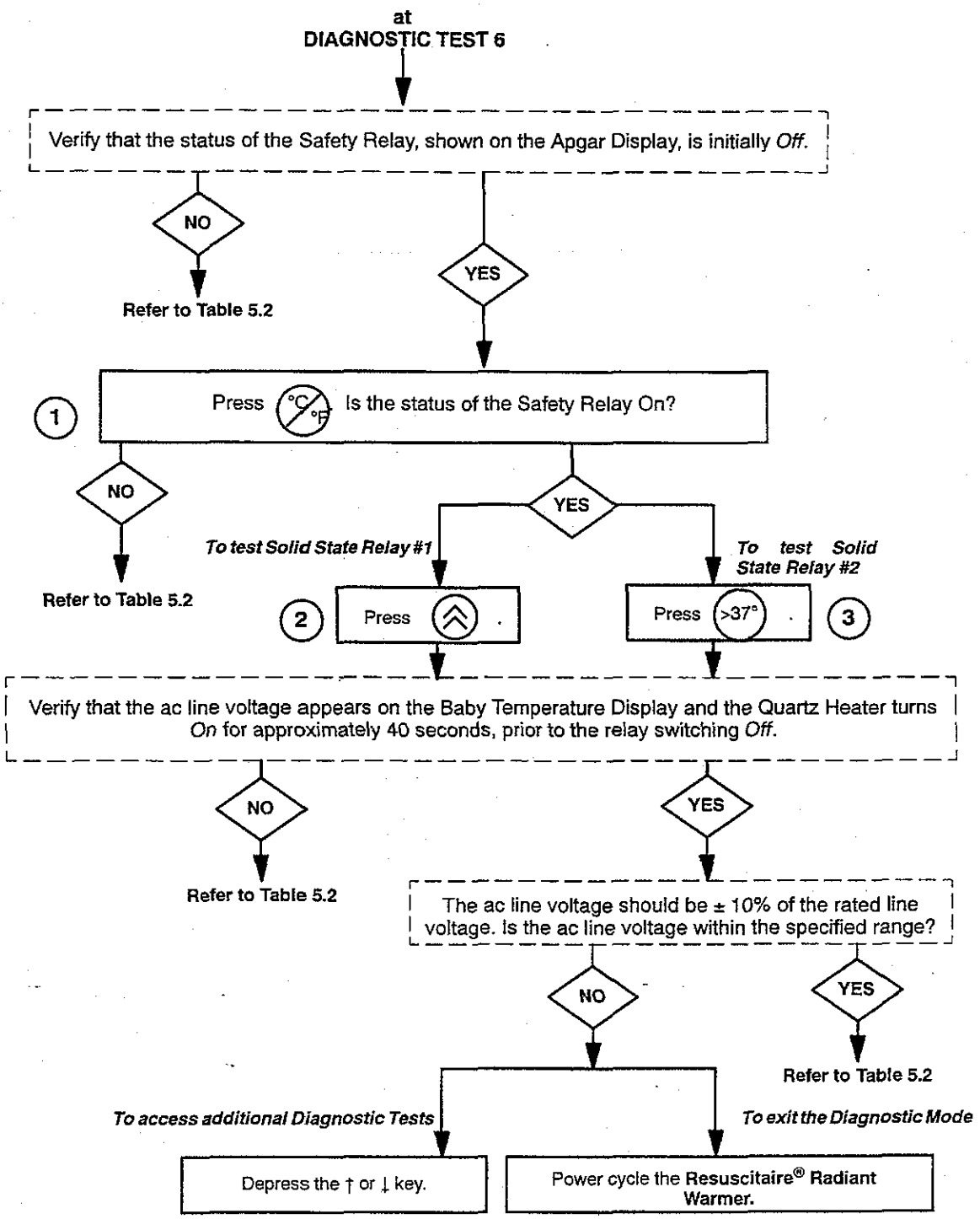


TABLE 5.A: AC LINE VOLTAGE CORRECTION PERCENTAGES

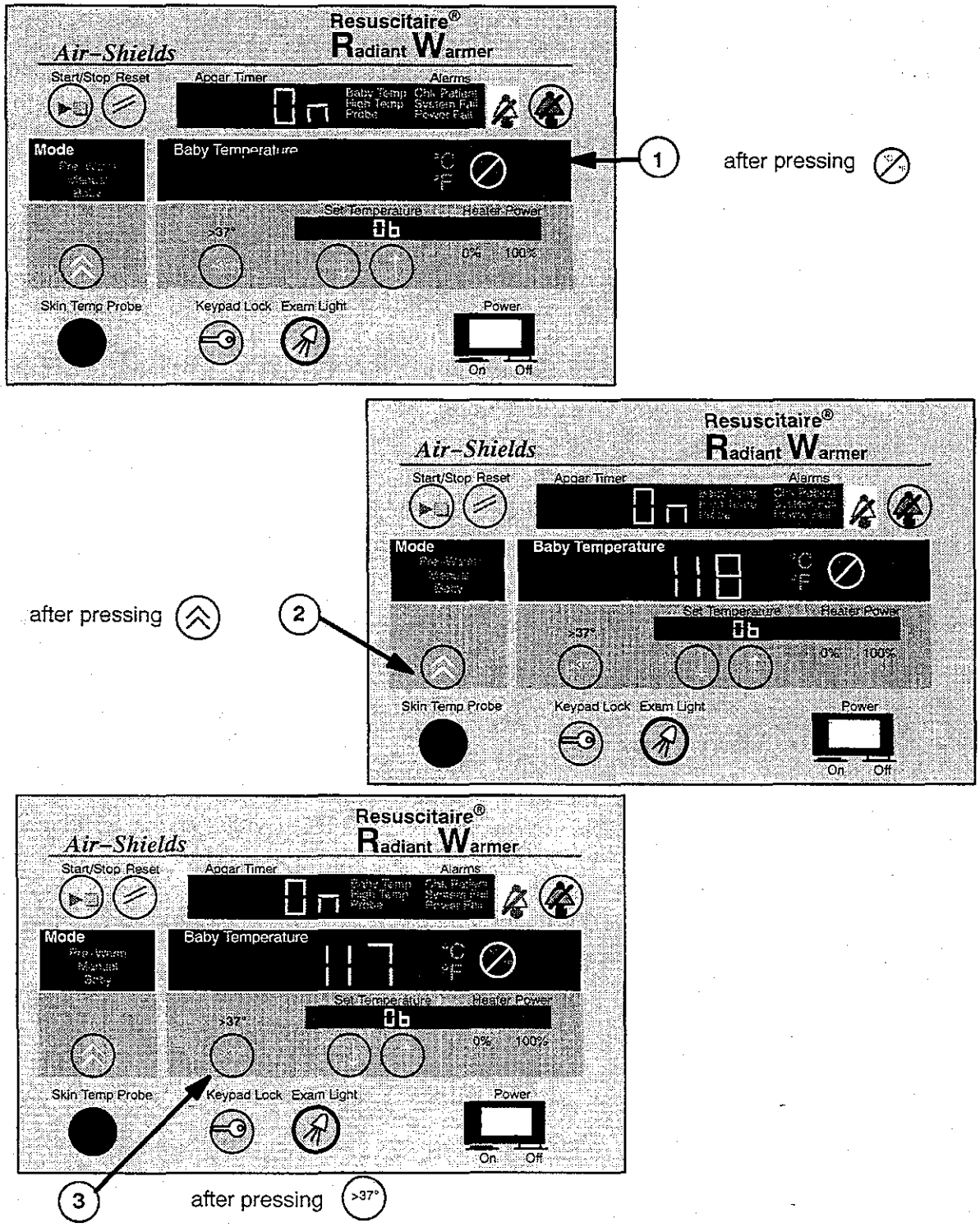
Corr %	AC Line Voltage	Corr %	AC Line Voltage	Corr %	AC Line Voltage	Corr %	AC Line Voltage
67	110	66	135	56	264	75	228
68	109	67	134	57	263	76	227
69	108	68	133	57	262	77	226
71	107	69	132	58	261	77	225
72	106	71	131	58	260	78	224
73	105	72	130	58	259	79	223
75	104	73	129	59	258	80	222
76	103	74	128	59	257	80	221
78	102	75	127	60	256	81	220
79	101	76	126	60	255	82	219
81	100	77	125	61	254	82	218
83	99	79	124	61	253	83	217
84	98	80	123	62	252	84	216
86	97	81	122	62	251	85	215
88	96	83	121	63	250	86	214
90	95	84	120	63	249	86	213
92	94	85	119	64	248	87	212
94	93	87	118	64	247	88	211
96	92	88	117	65	246	89	210
98	91	90	116	65	245	90	209
100	90	91	115	66	244	91	208
		93	114	66	243	91	207
		95	113	67	242	92	206
		96	112	67	241	93	205
		98	111	68	240	94	204
		100	110	69	239	95	203
		100	109	69	238	96	202
		100	108	70	237	97	201
		100	107	70	236	98	200
		100	105	71	235	99	199
		100		72	234	100	198
				72	233		
				73	232		
				73	231		
				74	230		
				75	229		

5.9.7 DIAGNOSTIC TEST 6 – AC Line Voltage Display

This test displays the AC Line Voltage read through Solid State Relay #1 (K4) and Solid State Relay #2 (K3). The Mean Line Voltage is shown on the Baby Temp Display. The status of the Safety Relay (K1) is shown on the Apgar Display.

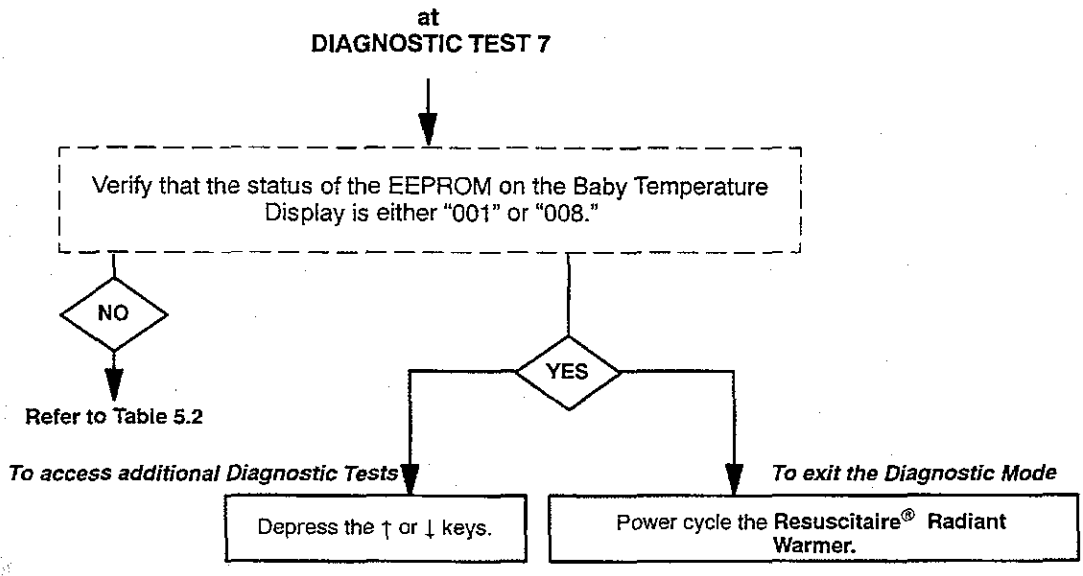

at
DIAGNOSTIC TEST 6
Verify that the status of the Safety Relay, shown on the Apgar Display, is initially Off.
NO
Refer to Table 5.2
YES
1
Press °C/°F. Is the status of the Safety Relay On?
NO
Refer to Table 5.2
YES
To test Solid State Relay #1
To test Solid State Relay #2
2
Press ⌃⌃.
Press >37°.
3
Verify that the ac line voltage appears on the Baby Temperature Display and the Quartz Heater turns On for approximately 40 seconds, prior to the relay switching Off.
NO
Refer to Table 5.2
YES
The ac line voltage should be ± 10% of the rated line voltage. Is the ac line voltage within the specified range?
NO
YES
Refer to Table 5.2
To access additional Diagnostic Tests
To exit the Diagnostic Mode
Depress the ↑ or ↓ key.
Power cycle the Resuscitaire® Radiant Warmer.

DISPLAY


Air-Shields
Resuscitaire®
Radiant Warmer
Start/Stop Reset
Apgar Timer
Alarms
Mode
Baby Temperature
Set Temperature
Heater Power
>37°
0%
100%
Skin Temp Probe
Keypad Lock
Exam Light
Power
On
Off
1
after pressing
2
after pressing
3
after pressing
>37°

5.9.8 DIAGNOSTIC TEST 7 – EEPROM Status Test

This test displays a four bit hexadecimal number which indicates the status of the EEPROM. The status flag is shown on the Baby Temperature Display. Under normal conditions, the status flag will be "001," indicating that the logic is functioning properly. On occasion, however, the status flag "008" will appear, indicating the initialization of a new EEPROM device or a 'write failure recovery.' A description of the known status flags is given in Table 5.B.


at
DIAGNOSTIC TEST 7
Verify that the status of the EEPROM on the Baby Temperature Display is either "001" or "008."
NO
YES
Refer to Table 5.2
To access additional Diagnostic Tests
To exit the Diagnostic Mode
Depress the ↑ or ↓ keys.
Power cycle the Resuscitaire® Radiant Warmer.

DISPLAY

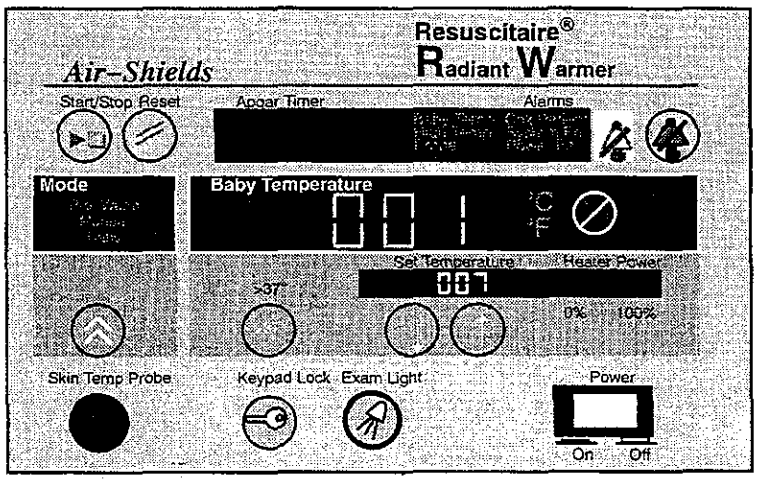
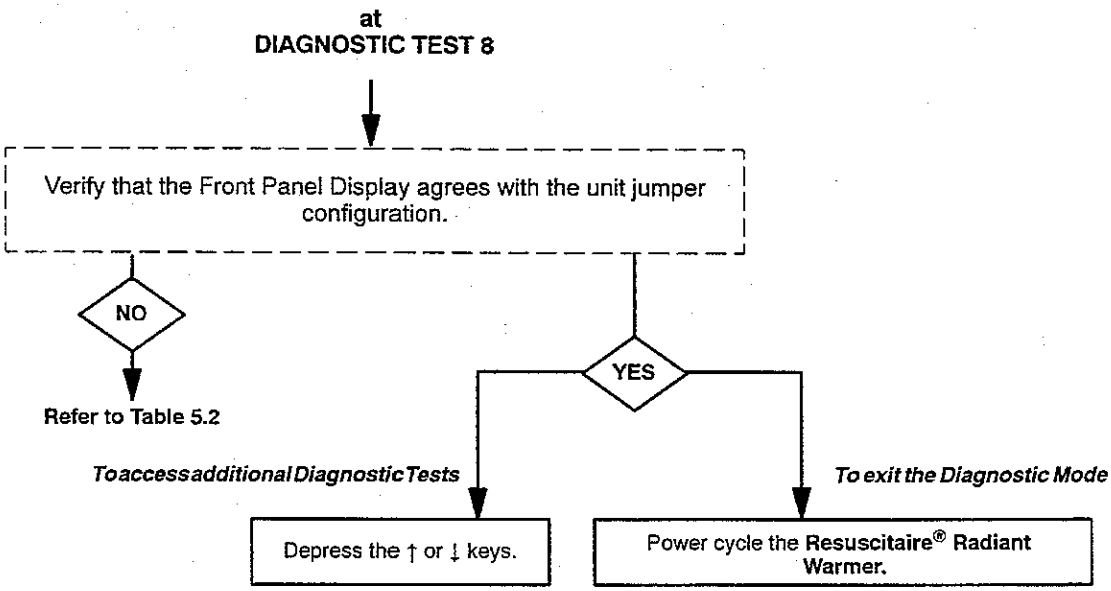


TABLE 5.B: STATUS FLAGS

Status Flag	Definition
000	EEPROM data block was never initialized
001	A valid EEPROM data block was found at init
002	Multiple EEPROM blocks were found at init
004	An unrecoverable EEPROM write failure occurred
008	A bulk erase operation was performed

5.9.9 DIAGNOSTIC TEST 8 – Unit Configuration Display

This test displays the unit configuration as read from jumpers (JP5 and JP6) on the Controller Board.


at
DIAGNOSTIC TEST 8
Verify that the Front Panel Display agrees with the unit jumper configuration.
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
Depress the ↑ or ↓ keys.
To exit the Diagnostic Mode
Power cycle the Resuscitaire® Radiant Warmer.

DISPLAY

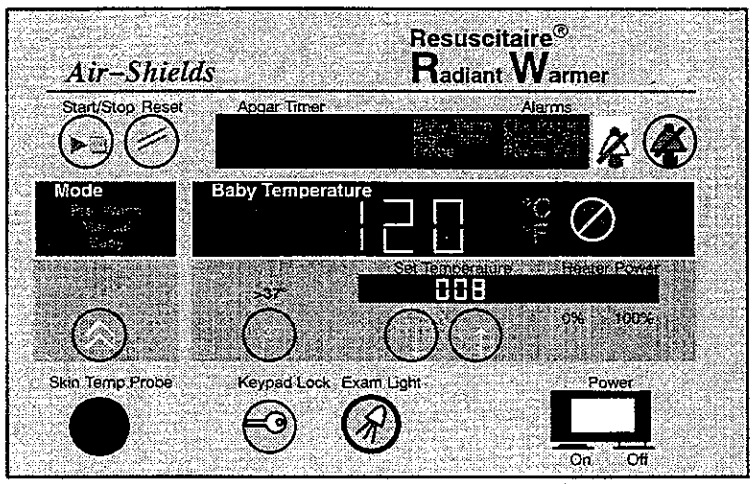


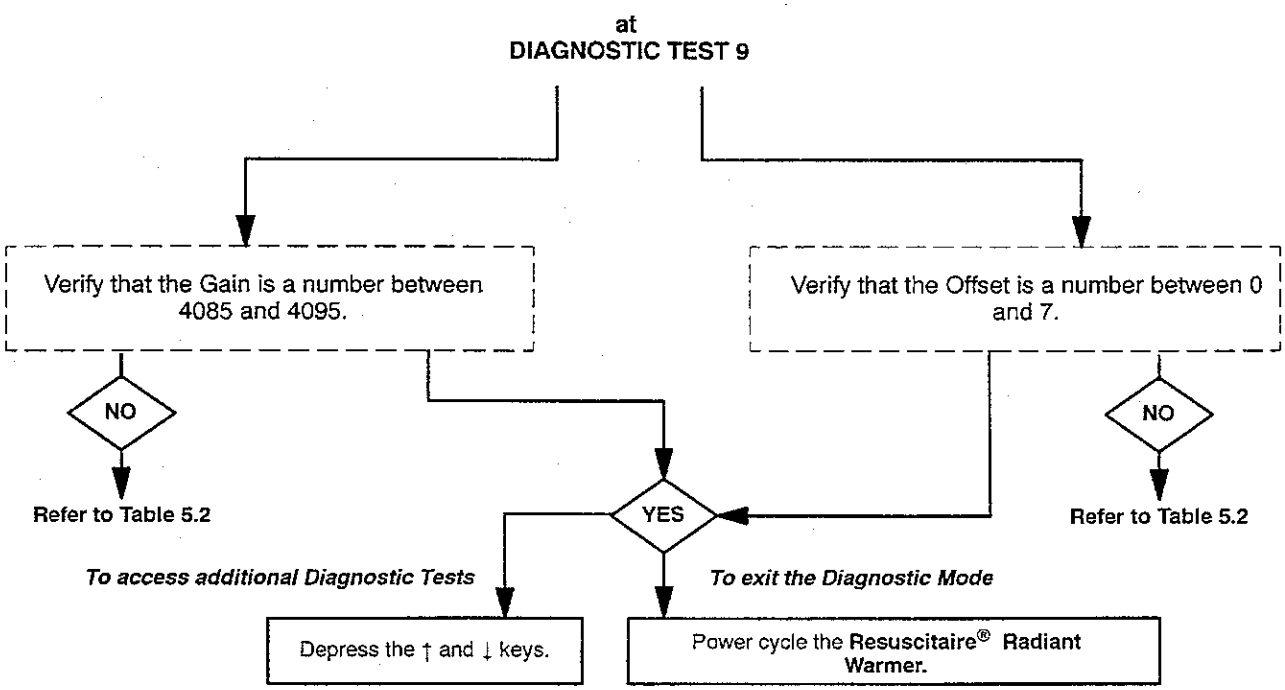
TABLE 5.C: UNIT CONFIGURATION

JP5	*JP6*	*UNIT CONFIG*	*FRONT PANEL DISPLAY*
on	*on*	*100 V 50/60 Hz*	*100*
off	*off*	*120 V 50/60 Hz*	*120*
off	*on*	*220 V 50 Hz*	*P220*
on	*off*	*220 V 50/60 Hz*	*220*

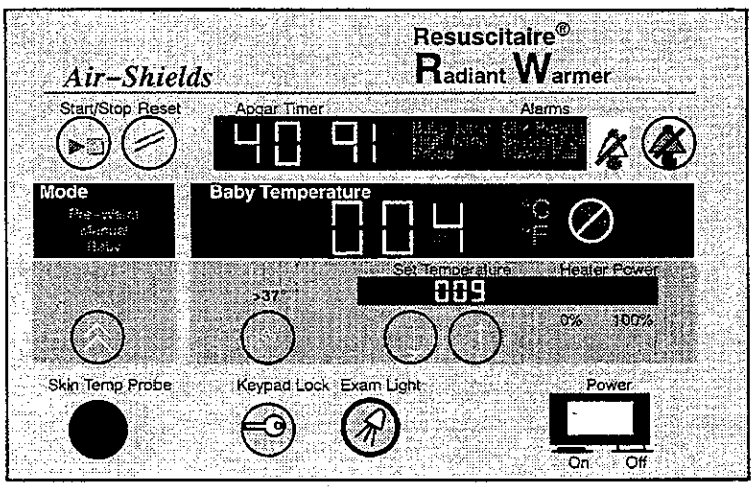
5.9.10 DIAGNOSTIC TEST 9 – ADC Offset/Gain Display

This test displays the ADC Gain and Offset on the Apgar and Baby Temperature Display, respectively. The external ADC reads the probe channels, probe calibration and ambient temperature. The Gain should be a number between 4085 and 4095. The Offset should be a number between 0 and 7.

NOTE: *If the ADC Gain is lower than 4085, FAIL will appear on the Apgar Display instead; and if the Offset is higher than 7, FAIL will appear on the Baby Temperature Display.*

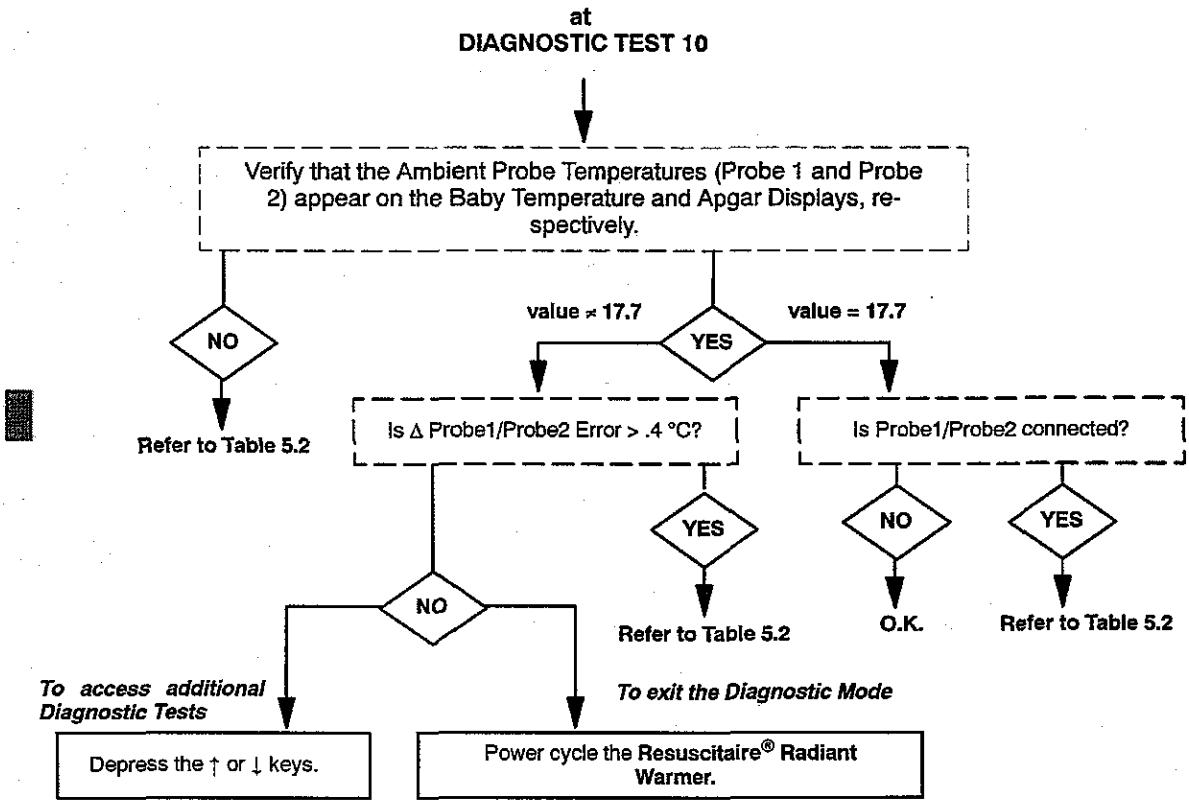

at
DIAGNOSTIC TEST 9
Verify that the Gain is a number between 4085 and 4095.
Verify that the Offset is a number between 0 and 7.
NO
Refer to Table 5.2
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
To exit the Diagnostic Mode
Depress the ↑ and ↓ keys.
Power cycle the Resuscitaire® Radiant Warmer.

DISPLAY

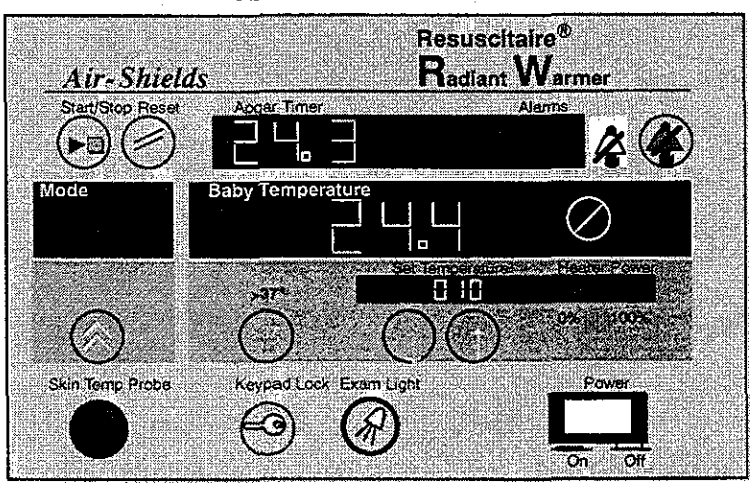


5.9.11 DIAGNOSTIC TEST 10 - Ambient Temperature Probe Display

This test displays the Ambient Probe Temperatures. Ambient Temperature Probe 1 is shown on the Baby Temperature Display. Ambient Temperature Probe 2 is shown on the Apgar Display. If there is no Ambient Temperature Probe, the value "17.7," which is the rail value, will appear on the Baby Temperature and/or Apgar Displays.

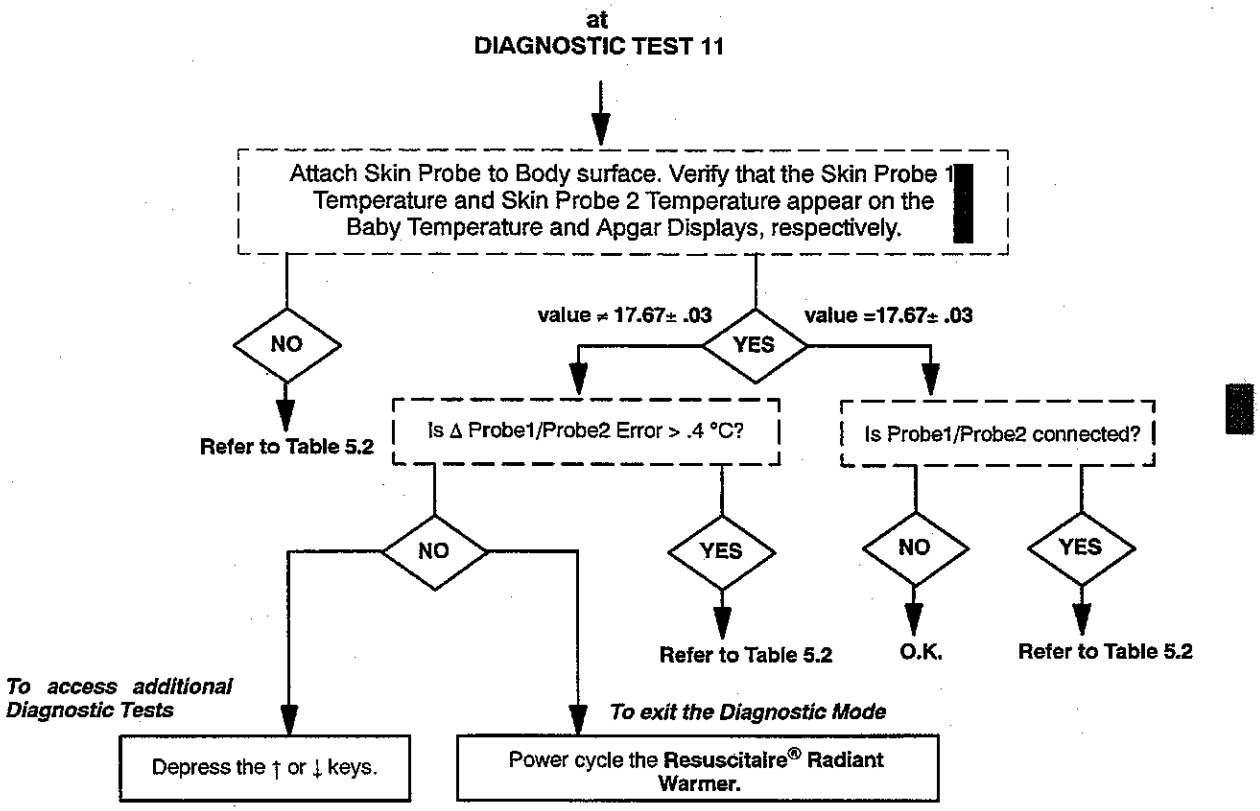


DISPLAY

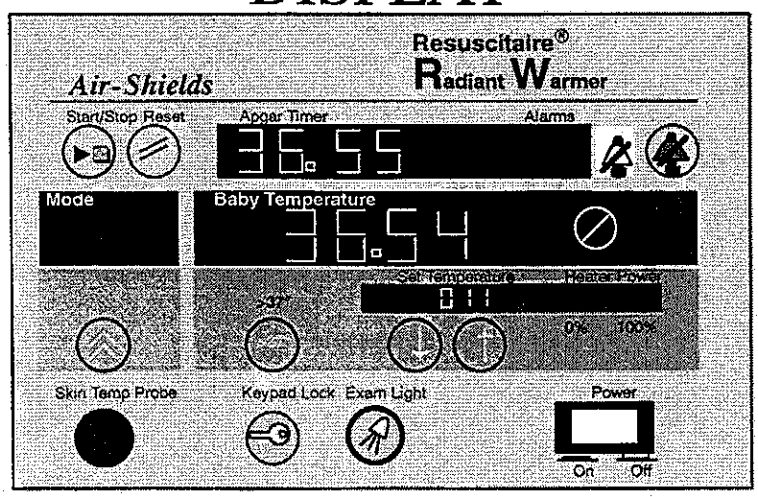


5.9.12 DIAGNOSTIC TEST 11 - Skin Probe Temperature Display

This test displays Skin Probe 1 temperature on the Baby Temperature Display and Skin Probe 2 temperature on the Apgar Display. If there is no Skin Temperature and/or Ambient Probe, the value "17.67 ± .03," which is the rail value, will appear on the Baby Temperature and/or Apgar Displays. This value will also appear if a problem exists.


at
DIAGNOSTIC TEST 11
Attach Skin Probe to Body surface. Verify that the Skin Probe 1 Temperature and Skin Probe 2 Temperature appear on the Baby Temperature and Apgar Displays, respectively.
NO
value ≠ 17.67± .03
YES
value =17.67± .03
Refer to Table 5.2
Is Δ Probe1/Probe2 Error > .4 °C?
Is Probe1/Probe2 connected?
NO
YES
NO
YES
Refer to Table 5.2
O.K.
Refer to Table 5.2
To access additional Diagnostic Tests
Depress the ↑ or ↓ keys.
To exit the Diagnostic Mode
Power cycle the Resuscitaire® Radiant Warmer.

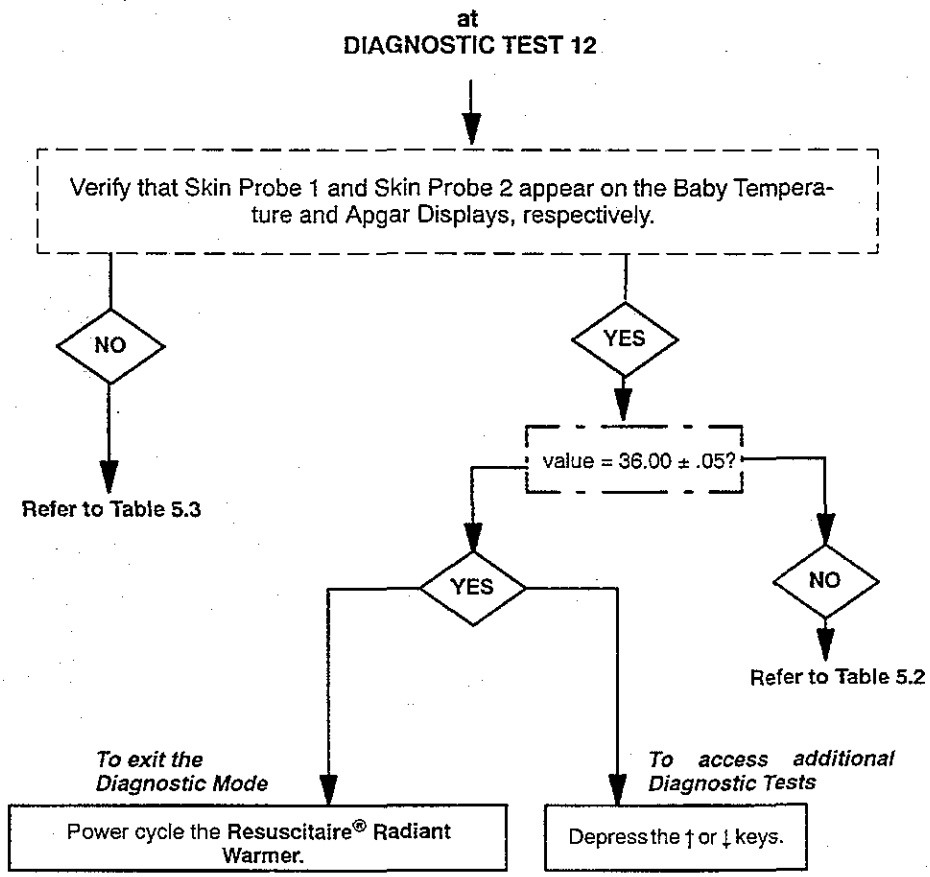
DISPLAY



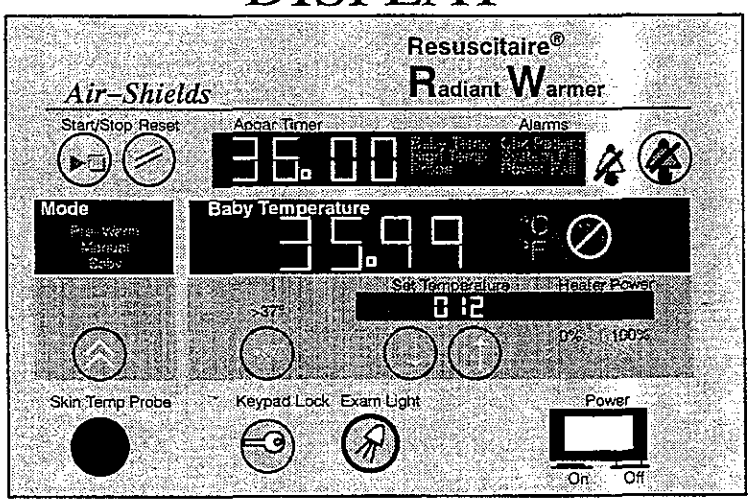
Change 5

5.9.13 DIAGNOSTIC TEST 12 – Skin Probe Ringout Temperature Display

This test displays the Skin Probe 1 ringout temperature on the Baby Temperature Display and the Skin Probe 2 ringout temperature on the Apgar Display. Both displays should read 36.00 °C ± .05 °C.

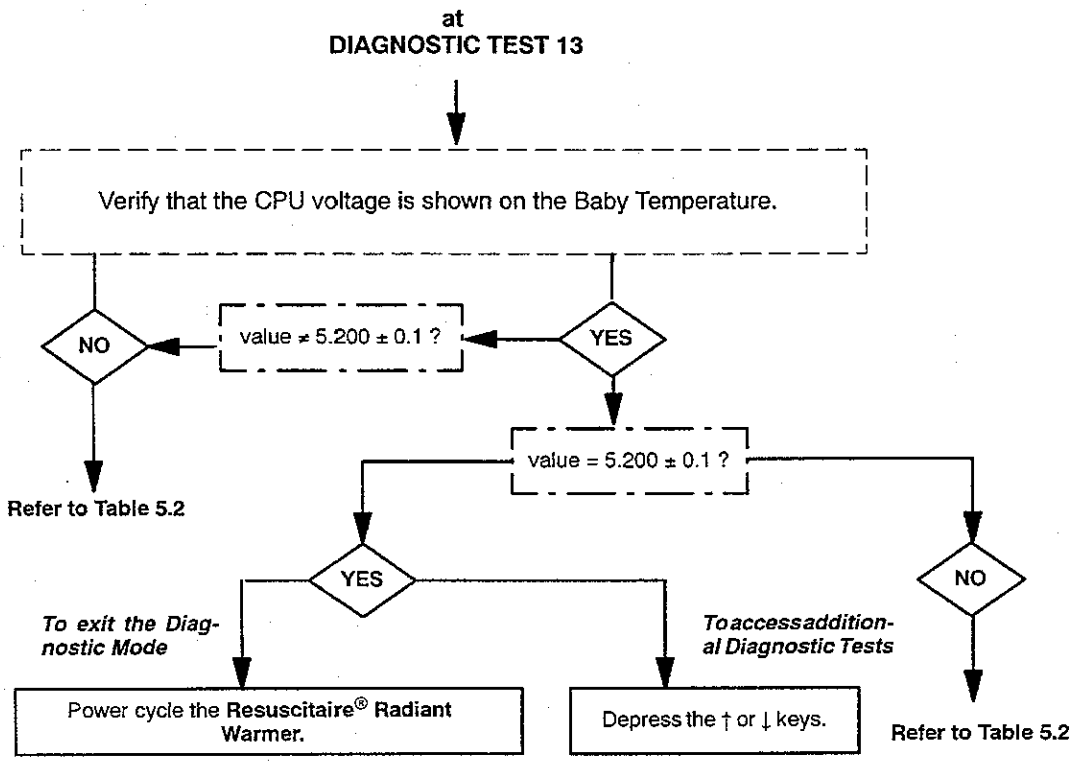

at
DIAGNOSTIC TEST 12
Verify that Skin Probe 1 and Skin Probe 2 appear on the Baby Temperature and Apgar Displays, respectively.
NO
YES
Refer to Table 5.3
value = 36.00 ± .05?
YES
NO
Refer to Table 5.2
To exit the Diagnostic Mode
To access additional Diagnostic Tests
Power cycle the Resuscitaire® Radiant Warmer.
Depress the ↑ or ↓ keys.

DISPLAY

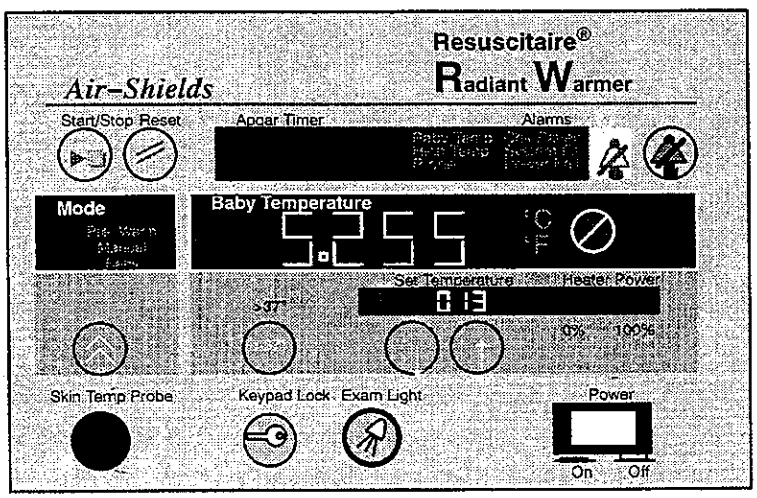


5.9.14 DIAGNOSTIC TEST 13 – Logic Voltage Display

This test displays the CPU Voltage on the Baby Temperature Display. The displayed value should be in the range of 5.200 ± 0.1 Vdc.

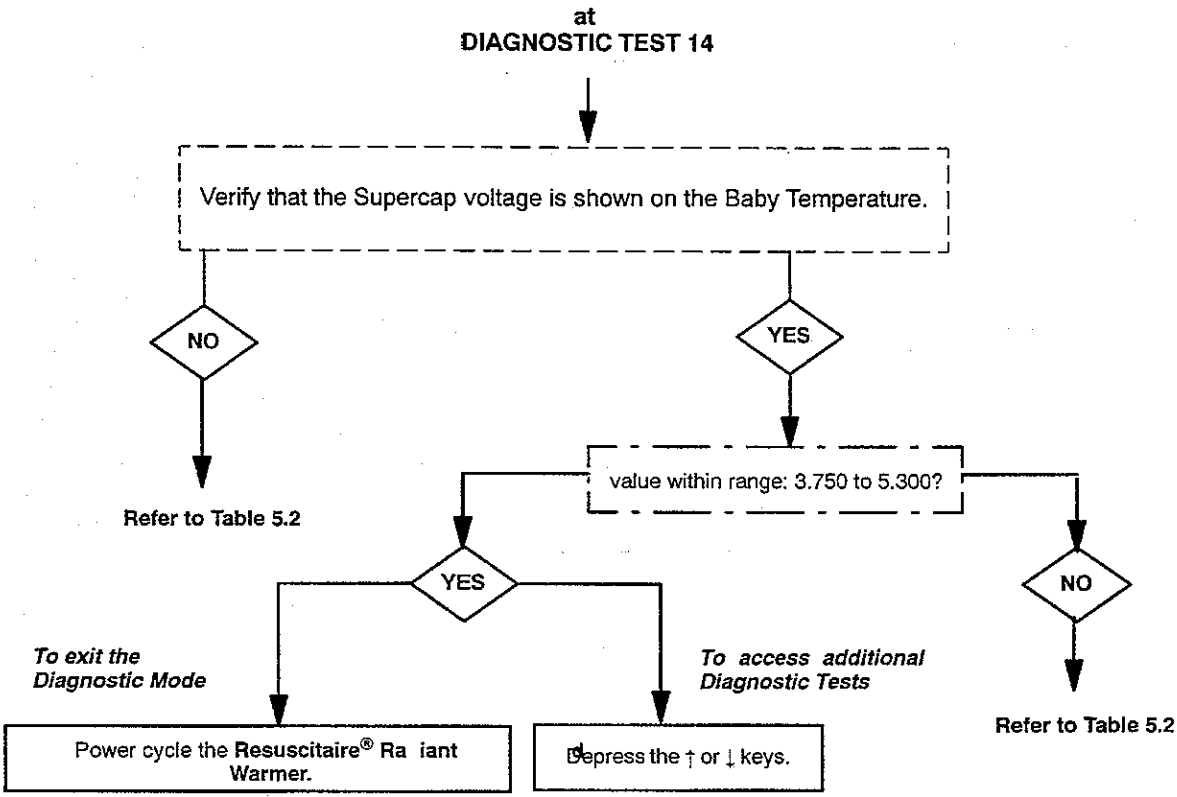

at
DIAGNOSTIC TEST 13
Verify that the CPU voltage is shown on the Baby Temperature.
value ≠ 5.200 ± 0.1 ?
NO
YES
Refer to Table 5.2
value = 5.200 ± 0.1 ?
YES
NO
To exit the Diagnostic Mode
To access additional Diagnostic Tests
Power cycle the Resuscitaire® Radiant Warmer.
Depress the ↑ or ↓ keys.
Refer to Table 5.2

DISPLAY

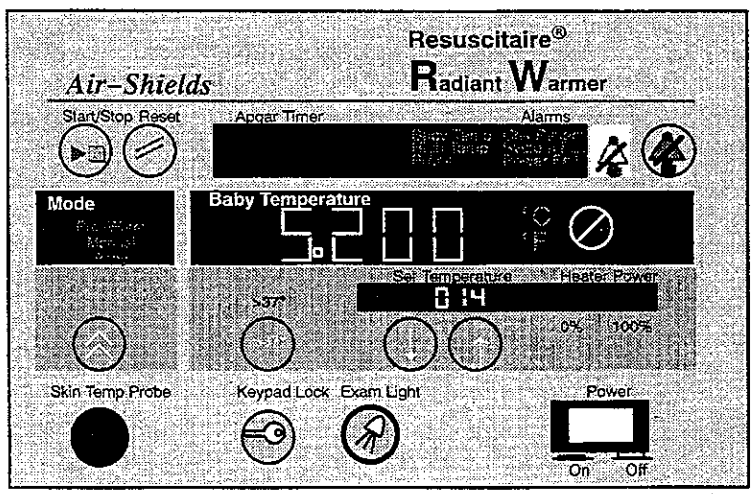


5.9.15 DIAGNOSTIC TEST 14 – Supercap Voltage Display

This test displays the Supercap Voltage of the Power Fail Detection Circuit on the Baby Temperature Display. The displayed value should be in the range of 3.750 to 5.300 Vdc.


at
DIAGNOSTIC TEST 14
Verify that the Supercap voltage is shown on the Baby Temperature.
NO
YES
Refer to Table 5.2
value within range: 3.750 to 5.300?
YES
NO
To exit the Diagnostic Mode
To access additional Diagnostic Tests
Refer to Table 5.2
Power cycle the Resuscitaire® Ra iant Warmer.
Depress the ↑ or ↓ keys.

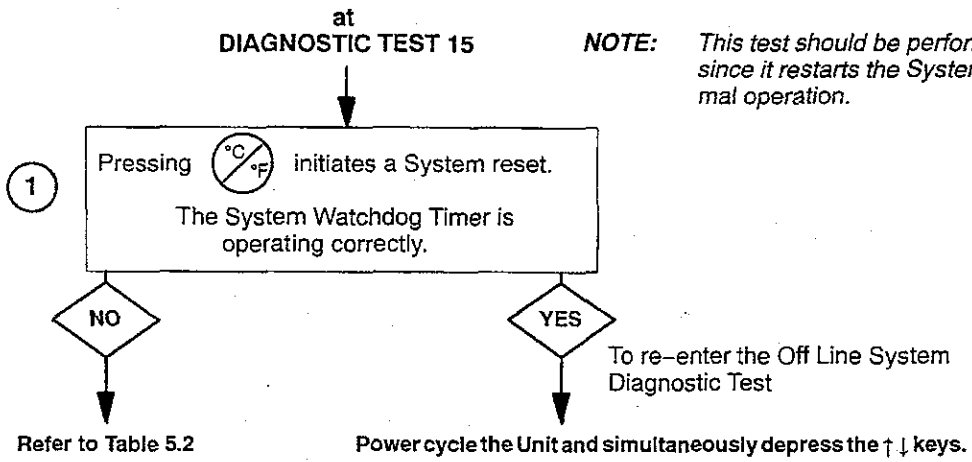
DISPLAY



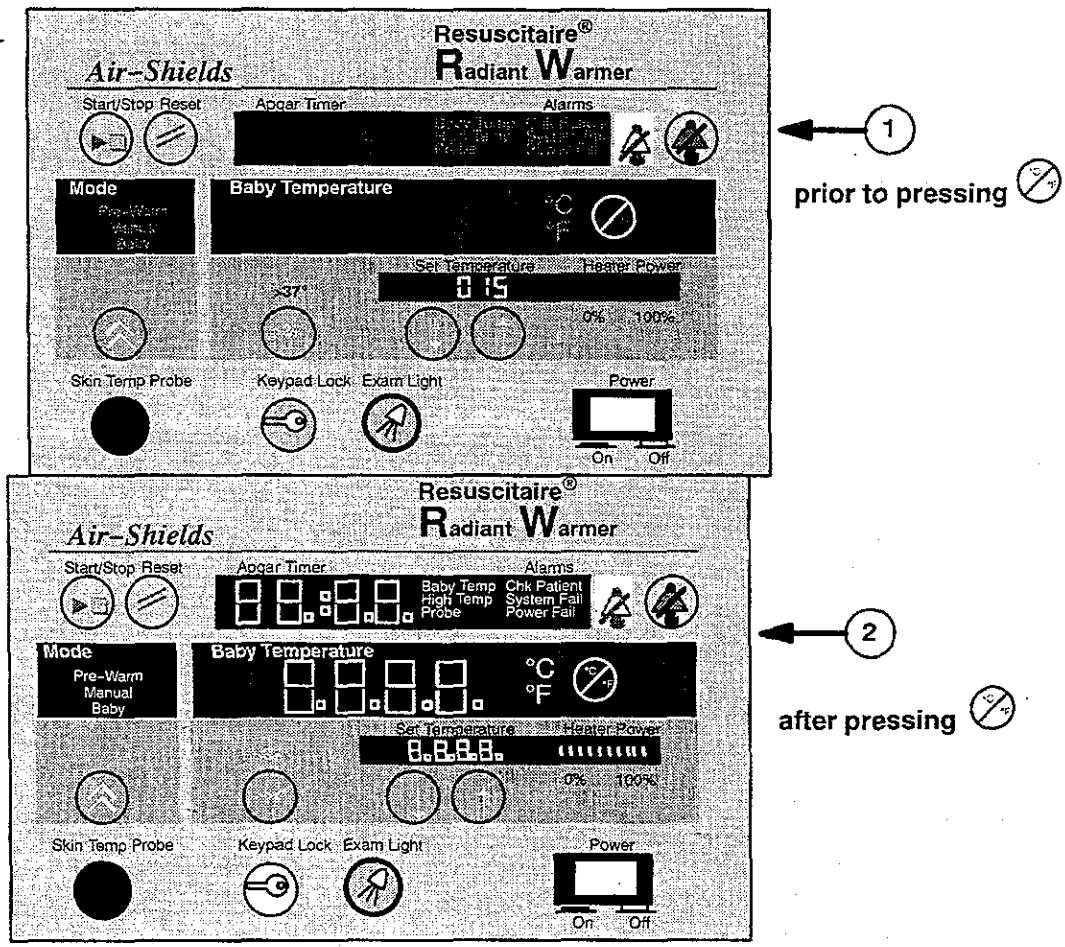
5.9.16 DIAGNOSTIC TEST 15 – Watchdog Timer Test

This test will initiate a Watchdog Timer time-out. Pressing °C/°F, at Test 15, will initiate a System reset.

NOTE: *This test should be performed last since it restarts the System in normal operation.*

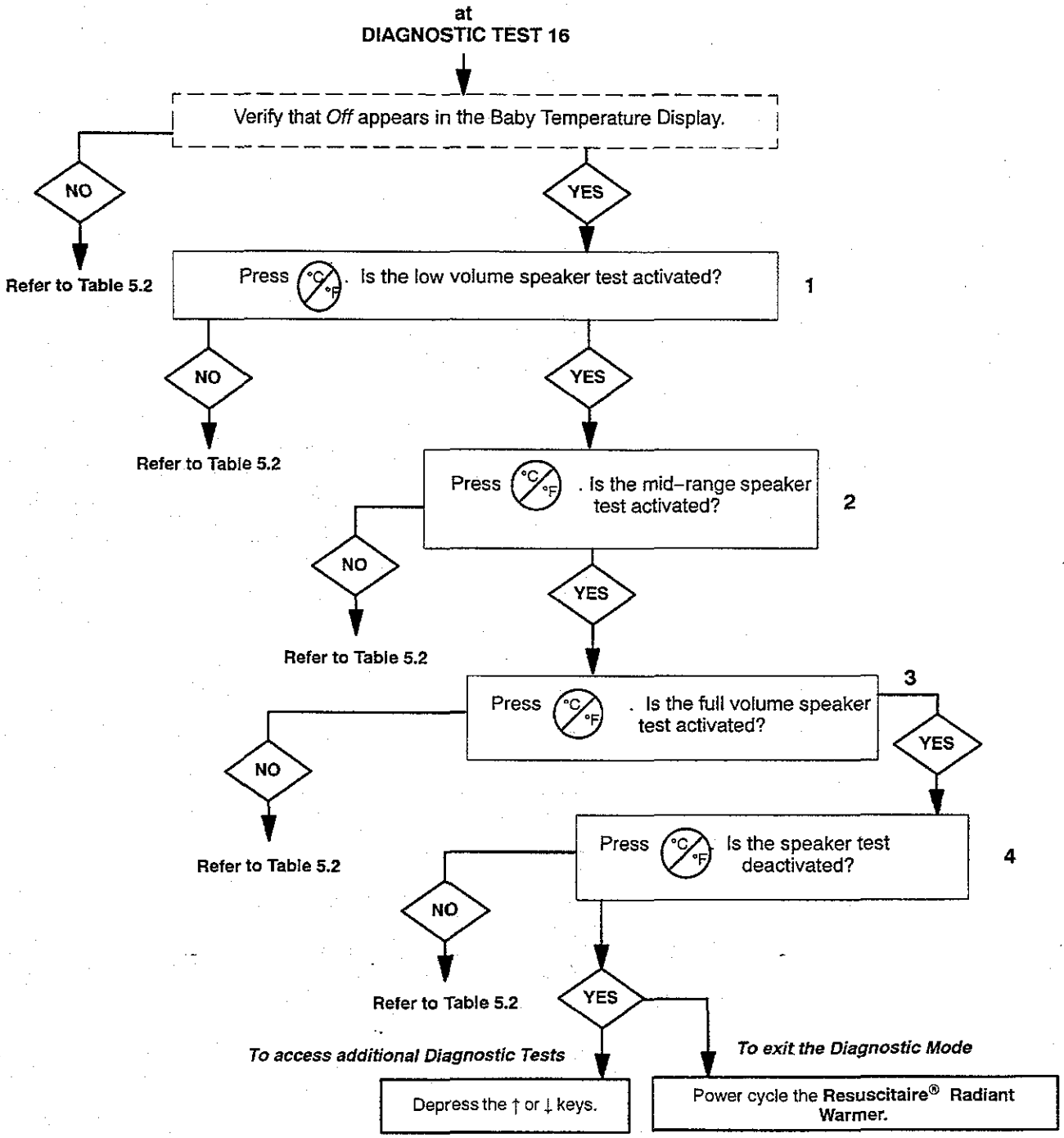

at
DIAGNOSTIC TEST 15
NOTE: This test should be performed last since it restarts the System in normal operation.
1
Pressing °C/°F initiates a System reset.
The System Watchdog Timer is operating correctly.
NO
YES
To re-enter the Off Line System Diagnostic Test
Refer to Table 5.2
Power cycle the Unit and simultaneously depress the ↑ ↓ keys.

DISPLAY

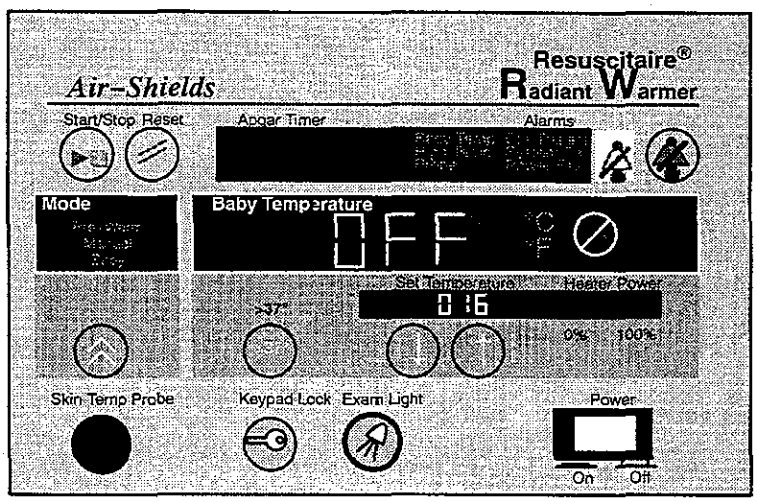


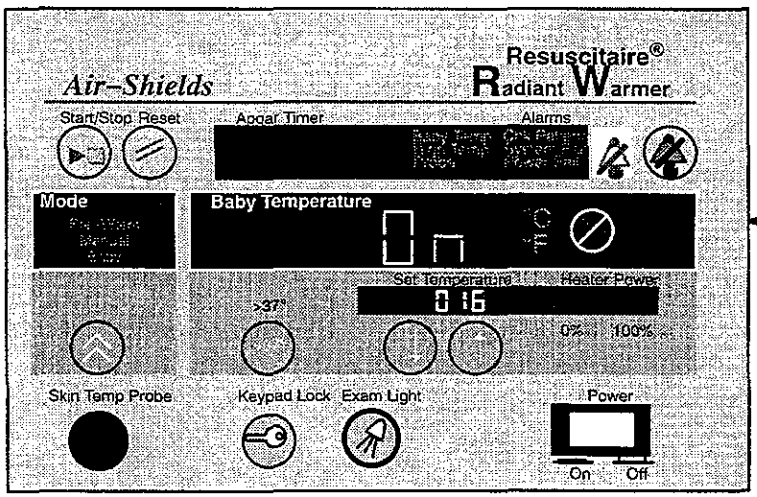
5.9.17 DIAGNOSTIC TEST 16 – Speaker Test

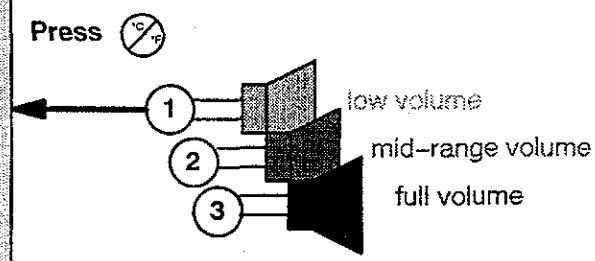
This test will activate the speaker test. Once the test has been activated, the three ranges (low volume, mid-range and full volume) of the speaker volume are tested by pressing °C/°F .

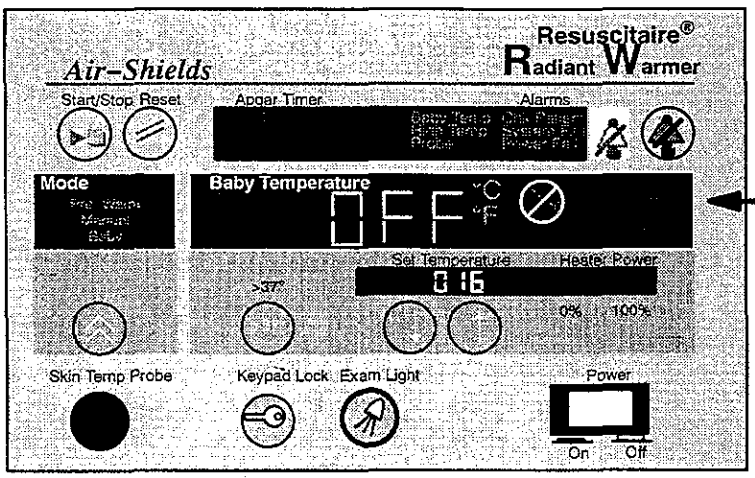


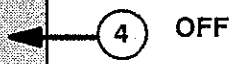
DISPLAY


Air-Shields
Resuscitaire®
Radiant Warmer
Start/Stop Reset
Apgar Timer
Alarms
Mode
Baby Temperature
OFF
Set Temperature
Heater Power
0:16
>37°
0%
100%
Skin Temp Probe
Keypad Lock
Exam Light
Power
On
Off


Air-Shields
Resuscitaire®
Radiant Warmer
Start/Stop Reset
Apgar Timer
Alarms
Mode
Baby Temperature
Set Temperature
Heater Power
0:16
>37°
0%
100%
Skin Temp Probe
Keypad Lock
Exam Light
Power
On
Off

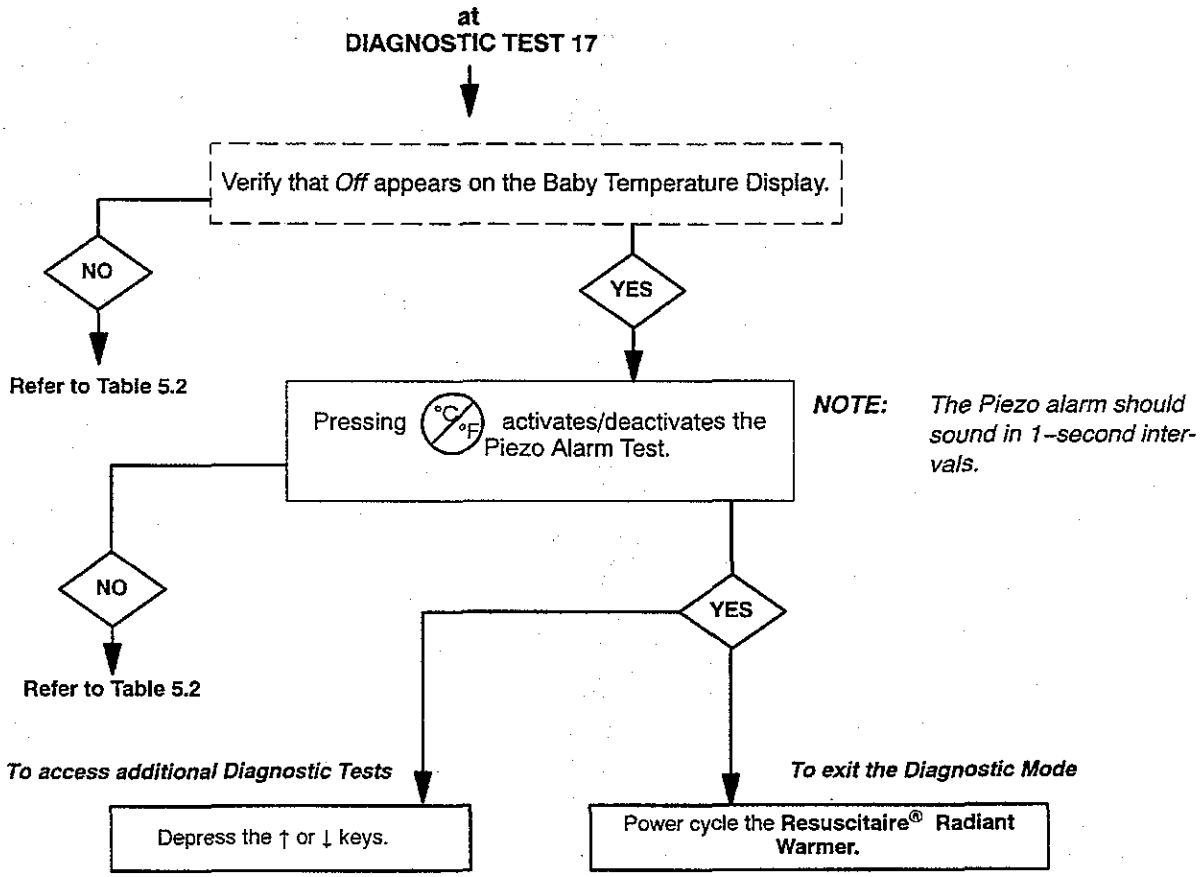

Press
1
low volume
2
mid-range volume
3
full volume


Air-Shields
Resuscitaire®
Radiant Warmer
Start/Stop Reset
Apgar Timer
Alarms
Mode
Baby Temperature
OFF
Set Temperature
Heater Power
0:16
>37°
0%
100%
Skin Temp Probe
Keypad Lock
Exam Light
Power
On
Off

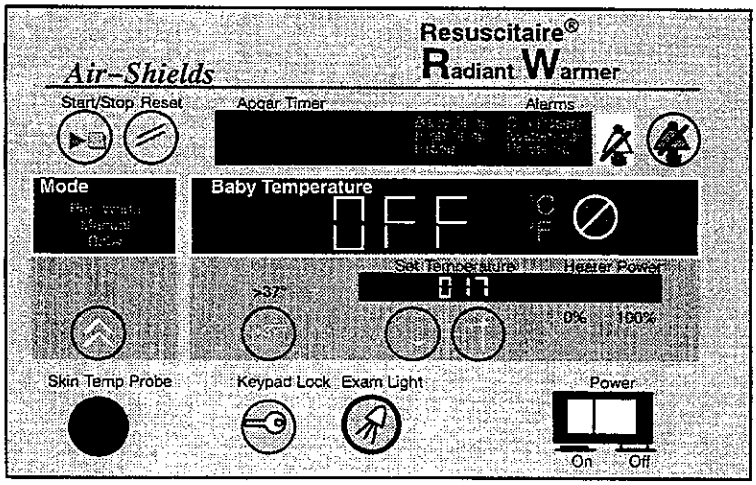

4
OFF

5.9.18 DIAGNOSTIC TEST 17 – Back-up Audio Annunciation Test

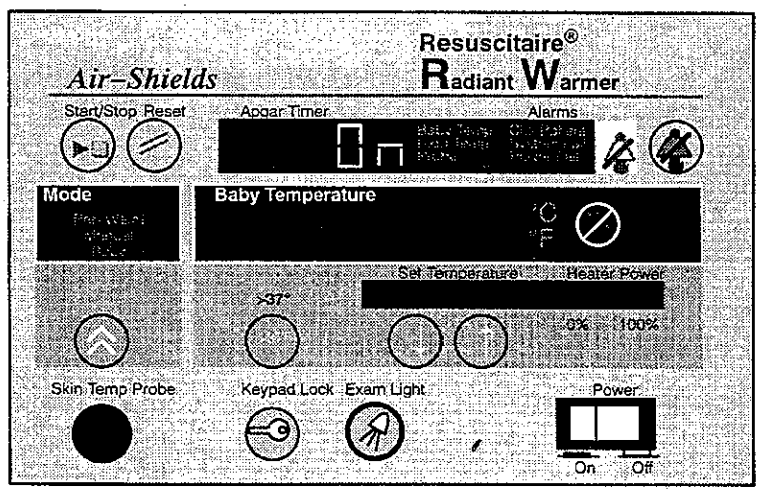
This test will exercise the Piezo Alarm. Pressing °C/°F at Diagnostic Test 17 will activate the Piezo Alarm.


at
DIAGNOSTIC TEST 17
Verify that *Off* appears on the Baby Temperature Display.
NO
YES
Refer to Table 5.2
Pressing °C/°F activates/deactivates the Piezo Alarm Test.
NOTE: The Piezo alarm should sound in 1-second intervals.
NO
YES
Refer to Table 5.2
To access additional Diagnostic Tests
To exit the Diagnostic Mode
Depress the ↑ or ↓ keys.
Power cycle the Resuscitaire® Radiant Warmer.

DISPLAY



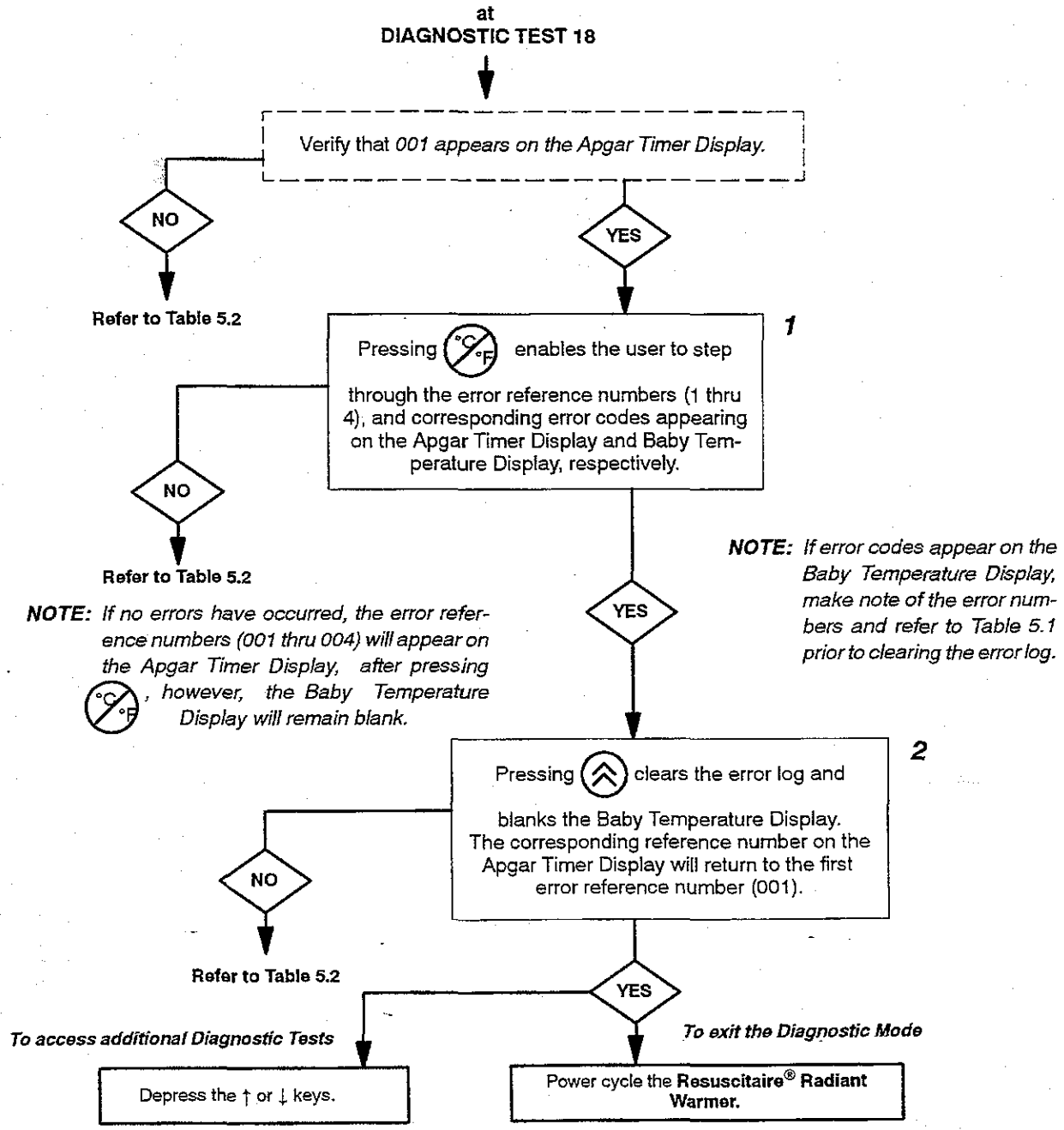
To activate.



To deactivate.

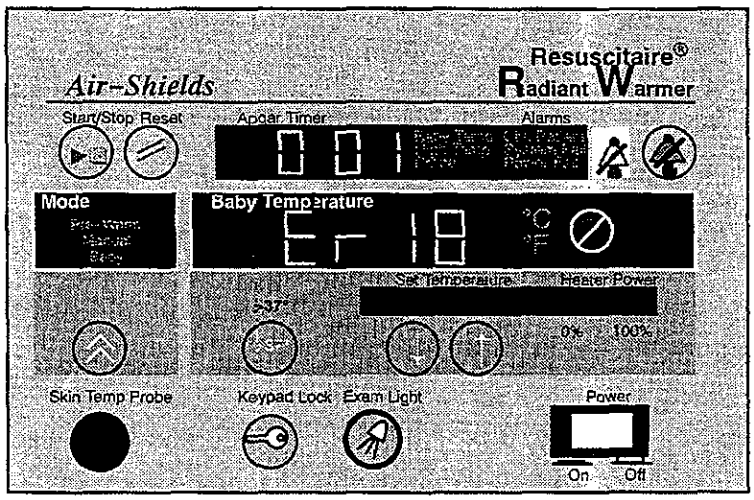
5.9.19 DIAGNOSTIC TEST 18 - Error Log Display/Clear (Only on Units with Firmware 1.05 and Higher)

This test will display the first 4 errors that may occur on the Baby Temperature Display. The numbers 1 thru 4 appearing on the Apgar Timer Display will indicate, to the user, the sequence in which the errors occurred. The ° C/° F key will enable the user to step through the error log entries. The Mode Key will enable the user to clear the error log.


at
DIAGNOSTIC TEST 18
Verify that 001 appears on the Apgar Timer Display.
NO
YES
Refer to Table 5.2
Pressing °C/°F enables the user to step through the error reference numbers (1 thru 4), and corresponding error codes appearing on the Apgar Timer Display and Baby Temperature Display, respectively.
1
NO
Refer to Table 5.2
NOTE: If error codes appear on the Baby Temperature Display, make note of the error numbers and refer to Table 5.1 prior to clearing the error log.
NOTE: If no errors have occurred, the error reference numbers (001 thru 004) will appear on the Apgar Timer Display, after pressing °C/°F, however, the Baby Temperature Display will remain blank.
YES
Pressing ⏫ clears the error log and blanks the Baby Temperature Display. The corresponding reference number on the Apgar Timer Display will return to the first error reference number (001).
2
NO
Refer to Table 5.2
YES
To access additional Diagnostic Tests
To exit the Diagnostic Mode
Depress the ↑ or ↓ keys.
Power cycle the Resuscitaire® Radiant Warmer.

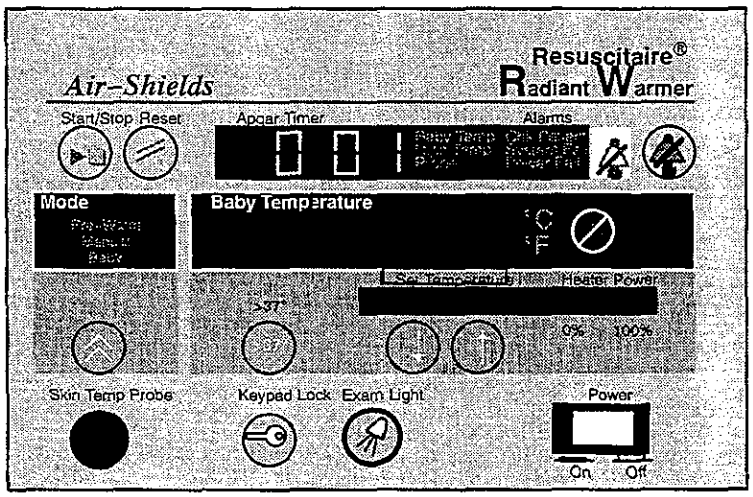
Change 1

DISPLAY



1

Errors Displayed.



2

Error Log Reset.

5.10 TROUBLESHOOTING

5.10.1 GENERAL TROUBLESHOOTING GUIDELINES FOR SYSTEM ERROR CODES

Below in Table 5.1 are Troubleshooting Guidelines for the **Resuscitaire® Radiant Warmer** System Error Codes.

TABLE 5.1: TROUBLESHOOTING GUIDELINES FOR SYSTEM ERROR CODES

ERROR NUMBER	EXPLANATION	POSSIBLE CORRECTIVE ACTION
ERROR #1	DELETED	
ERROR #2	AC LINE VOLTAGE TOO HIGH	Refer to Table 5.2, under Test 6.
ERROR #3	SSR'S PATH SHORTED	Replace PCB2.
ERROR #4	HEATER CIRCUIT FAILURE – SHORT	Replace PCB2.
ERROR #5	SSR#1 FAILURE – OPEN	Refer to Table 5.2 Test 6 Replace PCB2.
ERROR #6	SSR#2 FAILURE – OPEN	Refer to Table 5.2 Test 6 Replace PCB2
ERROR #7	SAFETY RELAY FAILURE – SHORT	Refer to Table 5.2, under Test 6.
ERROR #8	AC HEATER CURRENT HIGH	• Check the Quartz Tube Heating Element and replace if necessary. • Replace PCB2.
ERROR #9	HARDWARE DETECTION OF HIGH TEMPERATURE >39.5 °C	• If the heater is On, replace PCB2. • Check for an ancillary heat source.
ERROR #10	POWER FAIL CIRCUIT FAILURE	Replace PCB2.
ERROR #11	CPU VOLTAGE OUT OF SPEC	Refer to Table 5.2, under Test 13.
ERROR #12	KEYPAD FAILURE	Refer to Table 5.2, under Test 4.
ERROR #13	ROM TEST FAILURE	Refer to Table 5.2, under Test 2.
ERROR #14	RAM TEST FAILURE	Refer to Table 5.2, under Test 1.
ERROR #15	EEPROM TEST FAILURE	Refer to Table 5.2, under Test 7.
ERROR #16	A/D OFFSET OUT OF SPEC	Refer to Table 5.2, under Test 9.
ERROR #17	A/D GAIN OUT OF SPEC	Refer to Table 5.2, under Test 9.
ERROR #18	DELETED	
ERROR #19	NOT USED	
ERROR #20	EXTERNAL WATCHDOG TIMER FAIL	Replace PCB2.
ERROR #21	(AMBIENT TEMP PROBE 1/ AMBIENT TEMP PROBE) ERROR > .4 DEG C	Refer to Table 5.2, under Test 10.
ERROR #22	36 DEG PROBE CAL ERR> .2 DEG C	Refer to Table 5.2, under Test 12.
ERROR #23	AMBIENT TEMP TOO HIGH > 32 DEG C	Verify ambient temperature with an external thermometer.

5.10.2 GENERAL TROUBLESHOOTING GUIDELINES FOR SYSTEM DIAGNOSTIC CODES

Below in Table 5.2 are Troubleshooting Guidelines for the **Resuscitaire® Radiant Warmer** System Diagnostic Codes.

TABLE 5.2: TROUBLESHOOTING GUIDELINES FOR SYSTEM DIAGNOSTICS

TEST NUMBER	SYMPTOM	POSSIBLE CORRECTIVE ACTION
TEST #1	ERRONEOUS VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	• FAULTY U11 OR U12; REPLACE PCB1. • CHECK THE SOFTWARE REVISION LEVEL WITH LABEL ON U12.
TEST #2	ERRONEOUS VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	• FAULTY U11 OR U12; REPLACE PCB1. • ROM TEST FAILURE; REPLACE PCB2. • CHECK THE SOFTWARE REVISION LEVEL WITH LABEL ON U12.
TEST #3	ALL OF THE LEDs DO NOT TURN *ON* POWER FAIL LED DOES NOT BLINK PIEZO ALARM DOES NOT SOUND	REPLACE PCB1. REPLACE PCB2. • REPLACE PCB2. • REPLACE PIEZO ON FAN BRACKET (REFER TO FIGURE 6.7).
TEST #4	NO RESPONSE FROM THE APGAR START/STOP KEY NO RESPONSE FROM THE APGAR START/STOP KEY NO RESPONSE FROM THE SILENCE/ RESET KEY NO RESPONSE FROM THE MODE SELECT KEY NO RESPONSE FROM THE >37 KEY NO RESPONSE FROM THE °C/°F KEY NO RESPONSE FROM THE KEYPAD LOCK KEY	FAULTY S4; REPLACE PCB1. FAULTY S5; REPLACE PCB1. FAULTY S3; REPLACE PCB1. FAULTY S1; REPLACE PCB1. FAULTY S8; REPLACE PCB1. FAULTY S2; REPLACE PCB1. FAULTY S1; REPLACE S1 ON THE ELECTRICAL MODULE (REFER TO FIGURE 7.3).
TEST #5	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY THE VALUE APPEARING ON THE BABY TEMPERATURE DISPLAY DOES NOT AGREE WITH THE VALUES FOUND IN TABLE 5.A.	FAULTY U1; REPLACE PCB1. RUN DIAGNOSTIC TEST 6 FIRST TO VERIFY THE LINE VOLTAGE.

TABLE 5.2: TROUBLESHOOTING GUIDELINES FOR SYSTEM DIAGNOSTICS (CONT.)

TEST NUMBER	SYMPTOM	POSSIBLE CORRECTIVE ACTION
TEST #6	STATUS OF THE RELAY DOES NOT CHANGE	SAFETY RELAY FAILURE; REPLACE PCB2.
	HEATER RESISTANCE 120V 18–20Ω COLD	REPLACE HEATER
	HEATER RESISTANCE 220V 62–66Ω COLD	REPLACE HEATER
	AC LINE VOLTAGE IS TOO HIGH.	MAKE SURE POWER SOURCE IS IN COMPLIANCE WITH ELECTRICAL SPECIFICATION OF THE SYSTEM.
TEST #7	DISPLAY IS A HEXADECIMAL NUMBER OTHER THAN 001 OR 008	EEPROM TEST FAILURE; REPLACE PCB2.
TEST #8	FRONT PANEL DISPLAY OF THE UNIT CONFIGURATION DOES NOT AGREE WITH THE JUMPER (J5 AND J6) PLACEMENT	• CHECK JUMPER J5 AND J6, ON PCB2. • REPLACE PCB2.
TEST #9	GAIN IS OUTSIDE OF SPECIFIED RANGE, 4086–4094	FAULTY U4; REPLACE PCB1.
	OFFSET IS OUTSIDE OF SPECIFIED RANGE, 1 TO 8	FAULTY U4; REPLACE PCB1.
TEST #10	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	NO VALUE APPEARS ON THE APGAR DISPLAY	REPLACE PCB1.
	DIFFERENCE IN DISPLAYED TEMPERATURES EXCEED .4 °C	CHECK FOR FAULTY AMBIENT TEMPERATURE PROBE(S). ***NOTE:*** *THE AMBIENT PROBE IS INTERNAL. IT MUST BE ATTACHED IN ORDER FOR THE UNIT TO FUNCTION PROPERLY.*
TEST #11	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	NO VALUE APPEARS ON THE APGAR DISPLAY	REPLACE PCB1.
	DIFFERENCE IN DISPLAYED TEMPERATURES EXCEED .4 °C UNIT MAY RE-BOOT	CHECK FOR FAULTY SKIN TEMPERATURE PROBE(S). MAKE SURE PROBE IS NOT IN CONTACT WITH MATERIALS
TEST #12	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	NO VALUE APPEARS ON THE APGAR DISPLAY	REPLACE PCB1.
	VALUE ≠ 36.00 ± .02 °C	CALIBRATE SKIN PROBES; REFER TO SECTION 4.

Change 2

TABLE 5.2: TROUBLESHOOTING GUIDELINES FOR SYSTEM DIAGNOSTICS (CONT.)

TEST NUMBER	SYMPTOM	POSSIBLE CORRECTIVE ACTION
TEST #13	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	VALUE ≠ 5.200 ± .1 VOLTS °C	CHECK VOLTAGE FROM DC POWER SUPPLY.
TEST #14	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	SUPERCAP VALUE > 5.2 OR SUPERCAP VALUE < 3.750	FAULTY C29; REPLACE PCB2.
TEST #15	SYSTEM DOES NOT RESET	REPLACE PCB2.
TEST #16	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	PRESSING THE °C/°F KEY DOES NOT ACTIVATE THE LOW ALARM	REPLACE PCB2.
	PRESSING THE °C/°F KEY (x2 OR x3) DOES NOT INCREASE THE VOLUME	REPLACE PCB2.
TEST #17	NO VALUE APPEARS ON THE BABY TEMPERATURE DISPLAY	REPLACE PCB1.
	PRESSING THE °C/°F KEY DOES NOT ACTIVATE/DEACTIVATE THE PIEZO ALARM.	FAULTY POWER FAIL DETECTION CIRCUITRY; REPLACE PCB2.
TEST #18	NO VALUE APPEARS ON THE APGAR TIMER DISPLAY.	REPLACE PCB1.
	PRESSING THE °C/°F KEY DOES NOT SEQUENTIALLY STEP THROUGH THE ERROR LOG AND DISPLAY THE ERROR CODES ON THE BABY TEMPERATURE DISPLAY. ERROR LOG ONLY ON FIRMWARE 1.05 AND HIGHER.	REPLACE PCB1 (FAULTY BABY TEMP DISPLAY). REPLACE PCB2 (PROCESSOR ERROR).
	PRESSING THE MODE KEY DOES NOT CLEAR THE ERROR LOG.	REPLACE PCB2.
	PRESSING THE MODE KEY DOES NOT RETURN TO THE FIRST REFERENCE NUMBER (001).	REPLACE PCB2.

5.10.3 GENERAL TROUBLESHOOTING GUIDELINES FOR THE RADIANT WARMER HEAD

Below in Table 5.3 are Troubleshooting Guidelines specific to the Radiant Warmer Head Section of the **Resuscitaire® Radiant Warmer** System.

Change 1

TABLE 5.3: TROUBLESHOOTING GUIDELINES FOR THE RADIANT WARMER HEAD

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
HEATER DOES NOT TURN *ON*	FAULTY RELAY, K1	REPLACE PCB2.
	OPEN HEATING ELEMENT	REPLACE QUARTZ HEATING ELEMENT
	LOOSE CONNECTION AT J4	CHECK FOR LOOSE CONNECTION AT J4 ON PCB2.
	BROKEN PIN ON CONNECTOR J4	REPLACE PCB2.
THE PRE–WARM MODE IS NOT ACTIVATED UPON A RESET OF THE SYSTEM	SYSTEM IS IN THE DIAGNOSTIC MODE	EXIT THE DIAGNOSTIC MODE BY RE-SETTING THE SYSTEM.
	ROM FAILURE	REPLACE PCB2.
HEATER IS *ON*, BUT THE INDI-CATORS ARE *OFF*	FAULTY DISPLAY DRIVER	REPLACE PCB1.

5.10.4 GENERAL TROUBLESHOOTING GUIDELINES FOR THE PNEUMATIC HARDWARE

Below in Table 5.4 are Troubleshooting Guidelines specific to the Pneumatic Hardware Section of the **Resuscitaire® Radiant Warmer** System.

TABLE 5.4: TROUBLESHOOTING GUIDELINES FOR THE PNEUMATIC HARDWARE

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
SUCTION		
CAN NOT OB-TAIN THE DE-SIRED SUCTION PRESSURE	SUCTION JAR RIM GASKET WORN	REPLACE THE SUCTION JAR.
	SUCTION JAR LOOSE OR CHIPPED	TIGHTEN/REPLACE THE SUCTION JAR.
	CONNECTING HOSE IS BENT OR TANGLED	REPLACE THE HOSE.
	LEAK IN THE HOSE BETWEEN THE REGULATOR AND BOTTLE	REPLACE THE HOSE.
	PRESSURE OR SUCTION GAUGE NOT MEASURING CORRECTLY	REPLACE THE RESUSCITATION MOD-ULE.

TABLE 5.4: TROUBLESHOOTING GUIDELINES FOR THE PNEUMATIC HARDWARE (CONT.)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
BLENDER		
O_2 CONCENTRATION READING DOESN'T MATCH BLENDER SETTING	BLENDER IS INOPERABLE	REPLACE THE BLENDER MODULE.
	BLENDER KNOB IS LOOSE	TIGHTEN THE BLENDER KNOB.
THE BLENDER ALARMS	INPUT GAS SOURCE IS INCREASED/ DECREASED	CHECK THAT THE PIPELINE AND/OR CYLINDER GAS SOURCES.
		OPERATE THE LOW FLOW MICRO-BLENDER WITH CLEAN/DRY MEDICAL GRADE GASES.
OUTPUT MIXTURE IS OUTSIDE OF THE SPECIFIED RANGE (20.8% TO 100%)	BLENDER IS INOPERABLE.	USE AIR INLET WATER FILTERS.
		REPLACE THE BLENDER MODULE.
PATIENT GAS SUPPLY		
MEASURED FLOW FALLS OUTSIDE OF THE SPECIFIED ±3% OF FULL SCALE OR 10% OF SETTING	DIRTY OR BLOCKED AIR/O_2 HOSE	REPLACE HOSE.
PRESSURE RELIEF GAUGE EXCEEDS: 50 cmH_2O ± 10 cmH_2O	INOPERABLE PRESSURE RELIEF VALVE	REPLACE PRESSURE RELIEF VALVE.
AUTOBREATH		
1:2.4 <I/E RATIO <1.6:1 1:1	FAULTY LOGIC CIRCUIT	REPLACE RESUSCITATION MODULE.
MEASURE BPM OUTSIDE OF THE SPECIFIED 10 TO 60 BPM	FAULTY LOGIC CIRCUIT	REPLACE RESUSCITATION MODULE.

5.11 REMOVAL AND REPLACEMENT PROCEDURES

5.11.1 GENERAL

This section provides the removal and replacement procedures for components belonging to the **Resuscitaire® Radiant Warmer**. Removal and replacement of components not listed are obvious upon inspection.

5.11.2 REMOVING AND REPLACING THE BACK COVER (refer to Figure 6.1)

Removing the Back Cover

1. Unplug the power cord from the wall receptacle.
2. Unplug the power cord from the connector on the Upper Post (1) of the **Resuscitaire® Radiant Warmer.**

   NOTE: *Do not detach the cord from the cable clamp on the Back Cover (2).*

   For Pipeline Gas Supplies (on DISS and NIST Units, only)
3. Disconnect the pipeline supply hoses.

   For Cylinder Gas Supplies
4. Close the cylinder valves, using the attached cylinder wrench and remove the reserve gas cylinders.
5. Remove the Mounting Screws (19) securing the Back Cover to the Upper Post of the **Resuscitaire® Radiant Warmer.**

Replacing the Back Cover

6. Mount the Back Cover on the rear of the Upper Post and replace the four Mounting Screws securing the Back Cover.

   The next step applies to Cylinder Gas Supplies only
7. Replace the reserve gas cylinders and open the cylinder valves.

   The next step applies to Pipeline Gas Supplies only
8. Reconnect the pipeline supply hoses (for DISS and NIST Units, only).
9. Plug the power cord into the connector on the Upper Post of the **Resuscitaire® Radiant Warmer.**
10. Plug the power cord into the wall receptacle.

5.11.3 REMOVING AND REPLACING THE CONTROLLER MODULE (refer to Figure 6.1)

Removing the Controller Module

1. Remove the Back Cover (2).
2. Remove the Mounting Screws (20 and 40) securing the Controller Module (6) to the Head Support Plate (44).
3. Slide the Module through the opening in the front of the Upper Post, but do not remove the Module.
4. Prior to removing the Module, disconnect the Power Cable from J4 on the Controller Board.

Replacing the Controller Module

5. Align the wires with the center groove of the Controller Module and position the Module into the Upper Post. Make sure there is enough room to reconnect the Power Cable.
6. Reconnect the Power Cable to connector J4 on the Controller Board.
7. Slide the Module back into the opening in the front panel of the Upper Post and align the Module with the Mounting Screw holes in the Support Plate.
8. Replace the Mounting Screws.
9. Replace the Back Cover.

5.11.4 REMOVING AND REPLACING THE BLENDER MODULE (refer to Figures 6.1 and 6.6)

Removing the Blender Module

1. Remove the Back Cover (2).
2. Remove the Mounting Screws (40) securing the Blender Chassis to the Blender/ Resuscitation Support Plate (45).

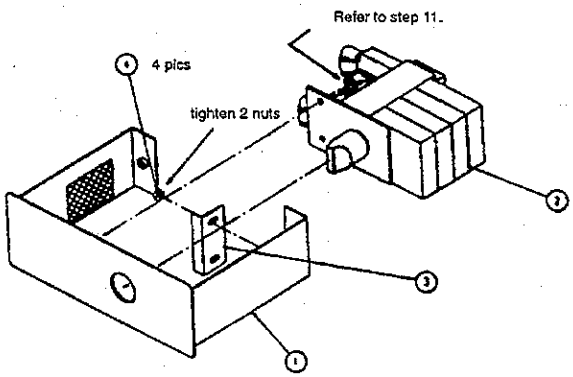
   IMPORTANT: *There are three tubing connections on the Blender. Before attempting to remove the tubing, mark each tube and its mating connector.*
3. Remove each tube from its mating connector by pushing in on the red collar of the fitting and simultaneously pulling the tube straight out.
4. Slide the Blender Chassis forward through the opening in the front of the Upper Post.
5. Remove the Blender Chassis from the Warmer Post.
6. Remove the existing Blender from the Chassis. The Blender Control Knob must not rub on the inside of the Front Panel clearance hole.

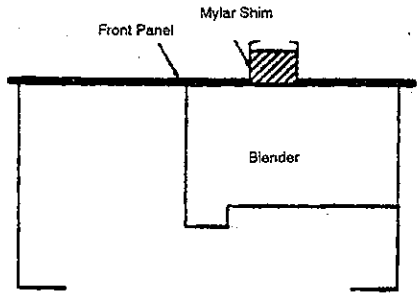
Replacing the Blender Module

7. Before installing the Blender provided, turn the Blender Control Knob fully clockwise.
8. Wrap the Mylar Shim provided around the Knob and secure it in place with a small piece of cellophane tape.
9. Install the replacement Blender in the Chassis.
10. Tighten the 2 nuts indicated.
11. Before tightening the remaining hardware, check that the Blender Control Knob turns freely. Then, tighten the remaining hardware and discard the shim.
12. Slide the Module back into the opening in the front panel of the Upper Post and align the Module with the Mounting Screw holes in the Support Plate.
13. Reconnect the tubing.

    NOTE: Secure the connection by firmly pushing the tubing into the fitting then pulling back. If the tubing remains in the fitting, a successful connection has been made. If not, repeat this step until a successful connection is made.

14. Before replacing the Back Cover, pressurize the system and listen for leaks. Alternatively, soapy water may be placed on the Blender Connectors.
15. Perform the checkout and performance procedures in Paragraphs 5.6 thru 5.8.
16. Replace the Back Cover.





5.11.5 REMOVING AND REPLACING THE RESUSCITATION MODULE

Removing the Resuscitation Module

1. Remove the Back Cover (2).
2. Remove the Mounting Screws securing the Resuscitation Module to the Blender/ Resuscitation Support Plate (46).
3. Disengage the tubing from the fitting marked "1." *If the Unit is equipped with a Blender Module*, disengage the tubing from the fittings marked "1," "2," "3" and "4."

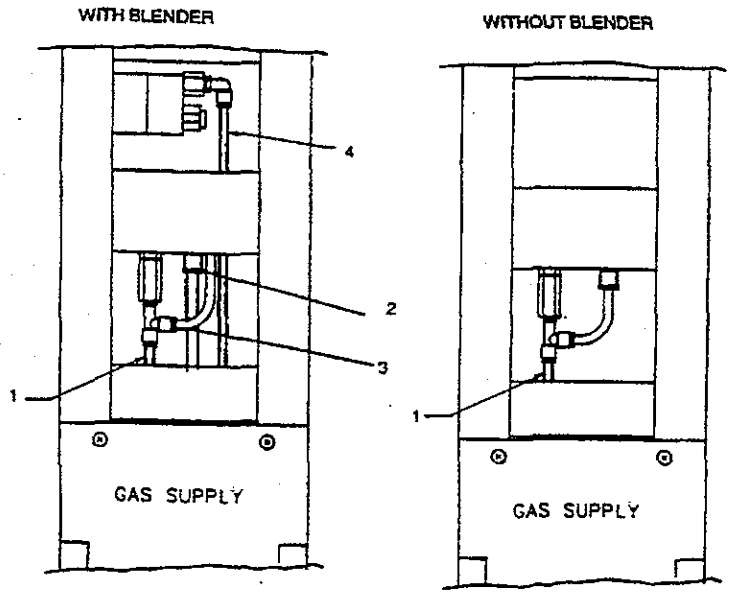
   NOTE:
   - *To remove the tubing, push in on the red collar of the fitting and pull the tubing straight out.*
   - *Mark the tubing with the appropriate numbers before removing.*
   - *It may be necessary to mark and disengage the "1" tubing after the Resuscitation Module is partially removed from the post.*
4. Slide the Module through the opening in the front of the Upper Post.
5. Remove the Module from the Upper Post.
6. Disconnect the Suction Tube from the white barb fitting in the Warmer Post.

Replacing the Resuscitation Module

7. Replace the Resuscitation Module.
8. Reconnect the Suction Tube to the white barb fitting.
9. Slide the Module back into the opening in the front panel of the Upper Post and align the Module with the Mounting Screw holes in the Support Plate.
10. Engage the tubing labeled "1" into the fitting marked "1." *If the Unit is equipped with a Blender Module, engage* the tubing labeled "1", "2", "3" and "4" with their corresponding marked fittings.

    NOTE: *Secure the connection by firmly pushing the tubing into the fitting then pulling back. If the tubing remains in the fitting, a successful connection has been made. If not, repeat this step until a successful connection is made.*

11. Replace the Mounting Screws.
12. Refer to Paragraphs 5.6 thru 5.8 and perform the checkout and performance procedures.
13. Replace the Back Cover.



5.11.6 REMOVING AND REPLACING THE GAS SUPPLY MODULE

Removing the Gas Supply Module

(Refer to Figure 6.1)

1. Turn *Off* and disconnect all gas supplies.
2. Place the On/Off Switch of the Gas Supply Module (9) to the *Off* position.
3. Remove the Back Cover (2).
4. Remove the dressed jam nut (41) on the On/Off Switch of the Gas Supply Module.
5. Remove the Mounting Screws, securing the Module to the Support Plate.

(Refer to Figures 6.10 thru 6.13)

6. Pull the top of the Chassis (1) away from the post, then lift the Chassis from the post.

   NOTE: *Be careful not to pull on the Suction Supply Tube.*

(Refer to Figures 7.5 and 7.6)

7. Disconnect the O_2 supply from the Chassis. *If applicable*, disconnect the air supply from the Chassis.

Replacing the Gas Supply Module

(Refer to Figure 6.1B)

8. Mount the flap, on the bottom of the Gas Supply Chassis, onto the post of the Unit.
9. Reconnect the O_2 supply. If applicable, reconnect the Air supply.
10. If necessary, remove the Gas Supply Chassis from the post, in order to properly align the Chassis with the holes on the front of the Unit.

NOTE:

- *Make sure that the Suction Tube is not pinched.*
- *Make sure that the toggle switch is facing downward.*

11. Replace the four Mounting Screws (40).
12. Replace the jam nut on the On/Off Switch.
13. Align the springloaded gauges with the cut-outs on the post.
14. Replace the Back Cover.
15. Refer to Paragraph 2.5 and perform steps 1 thru 3.
16. With the Patient Flow Rate (LPM) or Aux. Flow (LPM) Control set to 10 lpm, turn the On/Off Switch of the Gas Supply Module to the *Off* position and verify that there is no gas flow in the system.

NOTE: ***If gas continues to flow in the system, refer to Figures 7.5 and 7.6 and verify proper switch connections.***

5.11.7 REMOVING AND REPLACING THE QUARTZ HEATING ELEMENT

(refer to Figures 6.4, 6.5 and 7.4)

CAUTION: Prior to servicing the Unit, make sure the Unit is unplugged from the power source.

NOTE: *All procedures are done underneath the Warmer Head with the exception of the following procedures: 1) removing the Top Cover and 2) disconnecting/reconnecting the heater leads. These procedures are done on the top of the Warmer Head.*

Removing the Warmer Head Top Cover

(Refer to Figure 6.4)

1. Remove the six Mounting Screws (32) on the top of the Warmer Head (30). Lift the Top Cover of the Warmer Head away from the Unit.

NOTE: *To avoid misplacement of the mounting screws, store the mounting screws in a safe place.*

Disconnecting the Lead Wires

(Refer to Figure 7.4)

2. Disconnect the leads of the Quartz Heater Assembly from the two connectors (red and orange) of the wiring harness.

Removing the Heatshield

(Refer to Figure 6.5)

3. Remove the Screws (17 and 18) securing the Heatshield (9) to the End Plates (1).
4. Remove the Heatshield.

Removing the Retaining Springs and Secondary Reflector

(Refer to Figure 6.5)

5. Unfasten the Retaining Springs (21).
6. Remove the Retaining Springs and the Secondary Reflector (6).

Removing the Quartz Heater Assembly

(Refer to Figure 6.5)

7. Using the wire, slide the Quartz Heater Assembly (5) towards the front of the Warmer Head through the End Plate and Parabola Bracket (3).

Replacing the Quartz Heater Assembly

8. Replace the existing Quartz Heater Assembly.

CAUTION:

- **To avoid improper heating, be careful not to pull the metal ends away from the quartz tube.**
- **Do not touch the quartz tube with bare hands.**
- **If fingerprints are placed on the quartz tube, remove the fingerprints with alcohol.**

Warning: Do not adjust the heater mounting bracket. Adjusting the heater mounting bracket will disturb the alignment of the Quartz Heater Assembly.

NOTE: *The shorter heater lead must come out of the rear of the chassis.*

9. Reconnect the heater leads to the two connectors (red and orange) of the wiring harness.

Replacing the Retainer Springs

10. Make sure that the Ceramic Ends of the Quartz Heater Assembly are resting on the V-Notch of the Mounting Brackets.
11. Align the cut-out portions at either end of the Secondary Reflector with the lower tee portions of both Mounting Brackets and rest each end on the metal flanges just below the Mounting Brackets.
12. Lift one end of the Secondary Reflector above the hole in the lower tee of the Mounting Bracket and hold it in place.
13. Place the lower half of the Retaining Spring through the hole in the bottom portion of the Mounting Bracket.
14. Place the top half of the Retaining Spring around the ceramic end of the Quartz Heater Assembly and fasten the Retainer Spring.

CAUTION: Make sure that the Retainer Spring is not resting on the Metal Tip of the Quartz Heater Assembly.

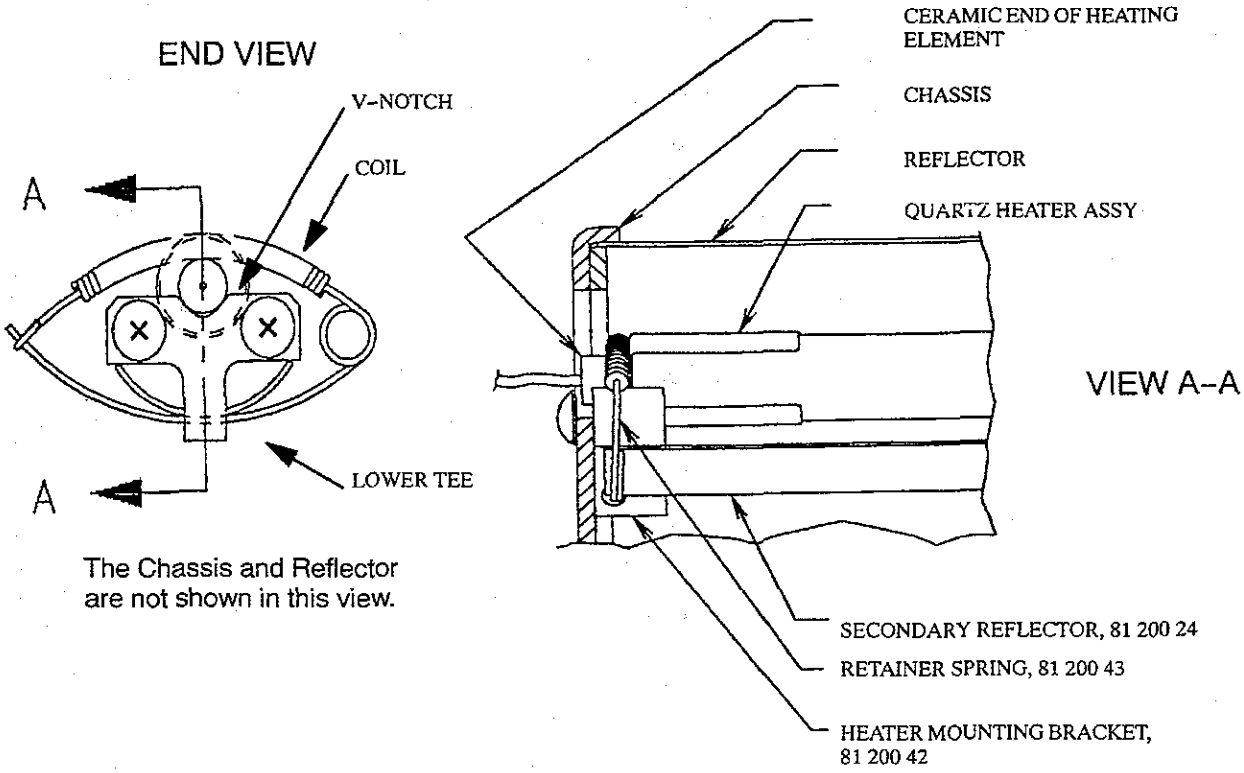
15. Lift the other end of the Secondary Reflector above the hole in the lower tee of the Mounting Bracket and hold it in place.
16. Repeat steps 13 and 14.

Replacing the Heatshield

17. Align the Heatshield with the mounting holes in the End Plates.
18. Replace the Screws securing the Heatshield to the End Plates.

Replacing the Warmer Head Top Cover

19. Align the Warmer Head with the mounting holes in the Chassis Shroud (1).
20. Replace the six Mounting Screws securing the Warmer Head to the Chassis.



5.11.8 REMOVING AND REPLACING THE CONTROLLER FRONT PANEL (refer to Figure 6.5)

Removing the Front Panel

1. Remove the Screws (53) securing the two top metal standoffs (63) to the Rear Panel (2). The Front Panel (1), PCB1 Assembly (6) and PCB2 Assembly (7) will swing downward from the Bottom Standoffs (62) and Hinge Standoffs (64).
2. Unscrew the two metal Top Standoffs (63).
3. Disconnect all the connectors from PCB1 and PCB2 Assemblies.
4. Locate the three metal anchors on the Front Panel securing PCB2 to the Front Panel.
5. Move the key slots on PCB2 to the unlocking position.
6. FOR KEYPAD LOCK, EXAM LIGHT AND POWER SWITCH REMOVAL:
   Place the right angle edge of the AMP Tool (AMP PN 91084-1) into the two grooves of the green portion of the Contacts. Press down on the Amp Unlocking Tool until a snap is heard.

   Pull up on blue portions of the Contacts until the Contacts (20, 21) are separated from the Actuators (10, 11, 12).

   Then remove the plastic nuts securing the Contacts (20, 21) to the Front Panel.

   FOR SKIN PROBE REMOVAL:
   Remove the shielded plastic housing from the brown, red and orange wires.

   Then remove the metal nut securing the Skin Probe Cable Assembly (36) to the Front Panel.

7. Slide the Keypad Lock, Exam Light, Power Switch and Skin Probe through their respective openings on the Front Panel.

8. Loosen and remove the two Hinge Standoffs from the Front Panel.

   NOTE: *Do not use the Bottom Standoffs as a torque in order to loosen the Hinge Standoffs from the Front Panel. This action may result in damage or breakage of the Screwlock (67).*

Replacing the Front Panel

9. Replace and tighten the two Hinge Standoffs (64) to the Front Panel.

   NOTE: *Do not use the standoffs (62) as a torque in order to tighten the Standoff Hinges to the Front Panel. This action may result in damage or breakage of the Screwlock.*

10. **FOR SKIN PROBE REPLACEMENT:**
Align the Skin Probe Receptacle with the designated opening on the Front Panel. Slide the Skin Probe Cable Assembly through the opening.

Replace the metal nut, securing the Skin Probe Cable Assembly, then replace the shielded plastic housing, encasing the brown, red and orange wires.

FOR KEYPAD LOCK REPLACEMENT:
Align the Actuator Assembly (11,14,18) with the designated opening on the Front Panel.

Replace the plastic nut securing the Actuator (11) to the Front Panel.

For Exam Light REPLACEMENT:
Align the Actuator Assembly (12,15) with the designated opening on the Front Panel.

Replace the plastic nut securing the Actuator (12) to the Front Panel.

For Power Switch REPLACEMENT:
Align the Actuator Assemblies (10,16) with the designated opening on the Front Panel.

Replace the plastic nut securing the Actuator (10) to the Front Panel.

11. Reconnect the Contacts and Cable Assemblies to the Actuators.
   NOTE: *No tool is required.*

12. Locate the keyed slots on PCB2. Engage the PCB Assemblies to the Front Panel by sliding the keyed slots on the PCB2 Assembly to the locking position.

13. Reconnect all of the connectors to the PCB Assemblies.

14. Secure the Top Standoffs to the Front Panel.

15. Replace the Screws, securing the top metal Standoffs to the Rear Panel.

5.12 RESUSCITATION MODULE CHECK AND CALIBRATION PROCEDURES

(Refer to Figures 7.5 and 7.6)

EQUIPMENT REQUIRED:

Screwdriver (Phillips)
PSI Gauge Assembly (PSI Gauge and Tubing)
Clamping Device (hemostat); maximum of 3
Digital Counter
Pressure Transducer
RT200 Tester or equivalent test device
Allen Wrenches
Relief Valve Cap (Part Number-TBA)
Patient Circuit

1. Remove the Blender and Resuscitation Module in accordance with Paragraph 5.11.
2. Place both Modules on the Cart and reconnect the tubing between the Blender and Resuscitation Gas Modules.

   NOTE: *Use extension tubing, if required.*
3. Supply regulated O_2 and Air to the Resuscitation Module. Both supplies should be regulated at 50 psi.

   NOTE: *If the Gas Module is used, make sure that the tubing is reconnected to the Resuscitation Module and the connections to the Gas Module are secure.*

4. Auxiliary Flow Check/Calibration

a. REGULATOR PRESSURE

Place the Suction On/Off Switch, on the Front Panel, in the *Off* position.

Set the Auxiliary Flow Control Knob, on the Front Panel, to zero.

Remove the orange plug line (TP1A) from the elbow of the Suction On/Off Switch (29) and connect a PSI Gauge Assembly in its place.

Measure the pressure setting of the Auxiliary Pressure Regulator (1). The regulator should be set at 20 psi.

If an adjustment is required, unlock the regulator by removing the wire tie and pressing up on the red ring. Adjust the knob until the pressure on the gauge reads 20 psi.

b. AUXILIARY FLOW/FLOW VALVE ZERO.

Connect the Auxiliary Outlet (2) to the connector on the RT200 Tester or equivalent test device corresponding to a high flow measurement.

At the Tester, select the test corresponding to a High Flow Range of 180 lpm.

Set the Auxiliary Flow Control Knob, on the Front Panel, to obtain a reading of 1 lpm on the RT200 Tester or equivalent test device.

If the reading on the Auxiliary Flow Control Knob does not correspond to the reading on the Tester, loosen the setscrews securing the Auxiliary Flow Valve (21) and position the Auxiliary Flow Control Knob to 1 lpm. Then retighten the setscrews.

Next, set the Auxiliary Flow Control Knob to obtain a reading of 15 lpm on the RT200 Tester or equivalent test device.

If the reading on the Auxiliary Flow Control Knob does not correspond to the reading on the Tester, loosen the setscrews securing the Auxiliary Flow Valve and position the Auxiliary Flow Control Knob to15 lpm. Then retighten the setscrews.

Return the Auxiliary Flow Control Knob to 1 lpm. Make sure that the Auxiliary Flow Control Knob position corresponds to the reading on the RT200 Tester or equivalent tester.

If the readings on the Auxiliary Flow Control Knob and the Tester are not in agreement, make further adjustments to the Auxiliary Pressure Regulator.

NOTE: *Make sure that the Regulator pressure remains between 20 ± 2 psi.*

Return the Auxiliary Flow Control Knob to zero. The reading on the Tester should not exceed .2 lpm.

Detach the hose connections.

c. Auxiliary Flow Relief Valve

Connect the Auxiliary Outlet (2) to the connector on the RT200 Tester or equivalent test device corresponding to a low pressure measurement.

At the Tester, select the test corresponding to a Low Pressure Range of 250 cm H_2O.

FOR RESUSCITATION MODULE PART NUMBERS 81 400 72, 73
Verify a reading on the tester of 160 cm H_2O ± 10%.
If required, adjust the spring in the Auxiliary Relief Valve to obtain 160 cm H_2O + 10%.

FOR RESUSCITATION MODULE PART NUMBER 81 400 80
Verify a reading on the tester of 40 cm H_2O ± 10%.
If required, adjust the spring in the Auxiliary Relief Valve to obtain 40 cm H_2O + 20%.

FOR RESUSCITATION MODULE PART NUMBER 81 400 81
Verify a reading on the tester of 160 cm H_2O ± 10%.
If required, adjust the spring in the Auxiliary Relief Valve to obtain 160 cm H_2O + 20%.

Detach the hose connections.

Lock the Auxiliary Regulator (1) by pressing down on the red ring. Secure the wire tie just above the red ring.

Remove the Pressure Gauge Assembly.

Replace the orange plug line.

The Aux Flow Check/Calibration is complete.

5. Suction Check/Calibration

a. SUCTION VALVE ZERO FLOW

Place the Suction On/Off Switch, on the Front Panel, in the *Off* position.

Connect the Suction Hose (22) to the connector on the RT200 Tester or equivalent test device corresponding to a low flow measurement.

FOR RESUSCITATION MODULE PART NUMBERS 81 400 73, 81
At the tester, select the test corresponding to a Low Flow Range of 5 lpm.

FOR RESUSCITATION MODULE PART NUMBERS 81 400 72, 80
At the tester, select the test corresponding to a Low Flow Range of 180 lpm.

Clamp off the Suction Gauge Line at junction (4).

Occlude the Vacuum Generator Exhaust (5).

Place the Suction On/Off Switch, in the *On* position.

Turn the Suction Control Knob, on the Front Panel, counter-clockwise until the flow rate on the Tester reads zero.

If the zero reading does not correspond to a "min" reading on the Suction Control Knob, loosen the setscrews securing the Suction Control Valve (23), and position the Suction Control Knob to the "min" position. Then retighten the setscrews.

Remove the clamping device.

Remove the occlusion from the vacuum exhaust.

Remove the hose connections.

b. GAUGE ACCURACY/MAXIMUM SUCTION RELIEF/GAUGE ZERO.

Connect the Suction Hose (22) to the connection on the RT200 Tester or equivalent test device corresponding to a low pressure measurement.

Select a Low Pressure Range of 185 mmHg on the Tester.

Slowly turn the Suction Control Knob clockwise. Compare the accuracy of the readings on the Suction Gauge to the readings on the RT200 Tester. The readings must be within 3% of full scale.

If necessary, make adjustments to the Suction Gauge with the zero adjusting screw on the top of the faceplate of the Suction Gauge.

NOTE: *In order to access the zero adjusting screw, remove the gauge from the Front Panel.*

Turn the Suction Control Knob to the "max" position (fully clockwise).

Verify a reading on the Tester of −150 ± 6 mmHg.

Adjust the spring tensioner in the Vacuum Relief Valve (6) in order to obtain −150 ± 6 mmHg.

Turn the Suction Switch *Off*. The needle on the Suction Gauge should read ± 1 mmHg.

Return the Suction Control Knob to the "min" position.

Detach the hose connections.

The Suction Check/Calibration is complete.

6. Patient Gas Supply Check/Calibration

a. REGULATOR PRESSURE

Set the Airway Pressure Relief Control Knob, on the Front Panel, to the "min" position.

Set the Flow Rate Control Knob, on the Front Panel, to zero.

Remove the pink plug line (TP7A) and connect a PSI Gauge Assembly in its place.

Measure the Patient Regulator pressure. The Patient Regulator (7) should be set at 20 psi.

If an adjustment is required, unlock the regulator by removing the wire tie and pressing up on the red ring. Adjust the knob until the pressure on the gauge reads 20 psi. Then, lock the regulator by pressing down on the red ring. Secure the wire tie just above the red ring.

Remove the PSI Gauge Assembly.

Replace the pink plug line.

b. AIRWAY PRESSURE GAUGE ACCURACY/ADJUSTABLE AIRWAY PRESSURE

Remove the Airway Pressure Relief Valve (8).

Occlude the opening in the manifold with the Relief Valve Cap.

Connect the Patient Outlet (9) to the connector on the RT200 Tester or equivalent test device corresponding to a low pressure measurement.

If this unit is equipped with an Airway Pressure Gauge Port (24), tee the Patient Outlet and Airway Pressure Gauge Port.

At the Tester, select the test corresponding to a Low Pressure Range of 250 cm H_2O.

Set the Flow Rate Control Knob, on the Front Panel, to 5 lpm.

Set the Airway Pressure Relief Control Knob, on the Front Panel, to "max."

If the reading on the Tester is not 80 cm H_2O, adjust the Airway Pressure Resistor (10), until the reading on the Tester is 80 cm H_2O.

Then slowly turn the Airway Pressure Relief Control Knob counter-clockwise. Compare the readings on the Tester with the readings on the Airway Pressure Gauge. Accuracy must be within ± 3% of full scale.

If necessary, use the zero adjusting screw at the top of the faceplate of the Airway Pressure Gauge. Adjust for the greatest accuracy below 50 cm H_2O.

NOTE: *In order to access the zero adjusting screw, remove the gauge from the Front Panel.*

Next, adjust the Airway Pressure Relief Control Knob until a reading of 50 cm H_2O is obtained on the Airway Pressure Gauge.

If the reading on the Tester is not 50 cm H_2O, adjust the Airway Pressure Resistor (10) until the reading on the Tester is 50 cm H_2O.

Then slowly turn the Airway Pressure Relief Control Knob counter-clockwise. Compare the readings on the Tester with the readings on the Airway Pressure Gauge. Accuracy must be within ± 3% of full scale.

If necessary, use the zero adjusting screw at the top of the faceplate. Adjust for the greatest accuracy below 50 cm H_2O (for Resuscitation Module Part Numbers 81 400 72, 80) or 60 cm H_2O (for Resuscitation Module Part Numbers 81 400 73, 81).

NOTE: *In order to access the zero adjusting screw, remove the gauge from the Front Panel.*

Remove the Relief Valve Cap.

Replace the Airway Pressure Relief Valve.

Set the Flow Rate Control Knob to zero.

Set the Airway Pressure Relief Control Knob to "min."

Detach the hose connections.

c. AIRWAY PRESSURE VALVE ZERO

Remove the orange plug line from the test port tee on the Airway Pressure Resistor Line (yellow). In place of the orange plug, connect a hose from the Airway Pressure Resistor Line to the connector on the RT200 Tester or equivalent test device corresponding to a low flow measurement.

Select a Low Flow Range of 5 lpm on the Tester.

Place a clamping device between the test port tee and Airway Pressure Resistor (on purple tee).

Place a clamping device on the yellow bleed resistor.

Turn the Airway Pressure Relief Control Knob, on the Front Panel, counter-clockwise until no flow is indicated on the Tester.

If necessary, loosen the setscrews securing the Airway Pressure Relief Control Valve (25), and position the Airway Pressure Relief Control Knob to the "min" position. Then retighten the setscrews.

Remove the clamping devices.

Detach the hose connections.

Replace the orange plug line.

d. AIRWAY PRESSURE GAUGE ZERO CHECK

Set the Airway Pressure Relief Control Knob to the "min" position.

Set the Patient Flow Valve to zero.

Verify that the Airway Pressure Gauge reads 0 ±1 cm.

e. PATIENT FLOW/PATIENT AIRWAY FLOW VALVE ZERO

NOTE: *Perform step e.* ***only if*** *the Unit is equipped with a Blender Module.*

Set the Blender Control Knob, on the Front Panel, to "60."

Connect the Patient Outlet (9) to the connector on the RT200 Tester or equivalent test device corresponding to a high flow measurement. If this unit is equipped with an Airway Pressure Gauge Port (24), tee the Patient Outlet and Airway Pressure Gauge Port.

At the Tester, select the test corresponding to a High Flow Range of 180 lpm.

Set the Airway Pressure Relief Control Knob, on the Front Panel, to "max."

Set the Flow Rate Control Knob, on the Front Panel, to "1."

If the position on the Flow Rate Control Knob does not correspond to the reading on the Tester, loosen the setscrews securing the Flow Rate Control Valve (26), and position the Flow Rate Control Knob to the "1" position. Then retighten the setscrews.

Next, set the Flow Rate Control Knob to obtain a reading of 15 lpm.

If the position on the Flow Rate Control Knob does not correspond to the reading on the Tester, connect the PSI Gauge Assembly to (TP7A). Unlock the Patient Regulator (7) by removing the wire tie and pressing up on the red ring. Adjust the knob until the pressure on the gauge reads 20 psi. Then, lock the regulator by pressing down on the red ring. Secure the wire tie just above the red ring. Remove the PSI Gauge Assembly.

Return the Patient Flow Valve to 1 lpm.

If necessary, loosen the setscrews on the Patient Flow Control Valve and reposition the Flow Rate Control Knob to the 1 lpm position in accordance to the reading on the Tester. Then retighten the setscrews.

Check the flow calibration at all settings of the Flow Rate Control Knob.

Return the Flow Rate Control Knob to the zero position. The reading on the Tester should not exceed .2 lpm.

Return the Blender Control Knob setting to 21%.

Return the Airway Pressure Relief Control Knob setting to "min."

Remove hose connections.

f. PATIENT AIRWAY RELIEF VALVE

Remove the Auxiliary Relief Valve (3) and install the Airway Pressure Relief Valve (8) in its place.

Connect the Auxiliary Outlet (2) to the connector on the RT200 (Low Pressure) or equivalent test device corresponding to a low pressure measurement.

At the Tester, select the test corresponding to a Low Pressure Range of 250 cm H_2O.

Slowly turn the Flow Rate Control Knob, on the Front Panel, counter-clockwise.

FOR RESUSCITATION MODULE PART NUMBERS 81 400 72, 80

Verify that a pressure of 50 ± 20% can be obtained over the full range of the flow.

If necessary, adjust the spring in the Airway Pressure Relief Valve to obtain 50 + 20% over the full range of the flow.

FOR RESUSCITATION MODULE PART NUMBERS 81 400 73, 81

Verify that a pressure of 60 ± 20% can be obtained over the full range of the flow.

If necessary, adjust the spring in the Airway Pressure Relief Valve to obtain 50 + 20% over the full range of the flow.

Return the Flow Rate Control Knob to zero.

Remove the Airway Pressure Relief Valve and replace it in its proper manifold location.

Replace the Auxiliary Relief Valve in its proper manifold location.

Detach the hose connections.

The Patient Gas Supply Check/Calibration is complete.

7. Autobreath Calibration

a. LOGIC REGULATOR

Remove the orange plug line (TP11A) from the elbow on the back of the Autobreath On/Off Switch, on the Front Panel, and connect a PSI Gauge Assembly in its place.

Measure the pressure of the Autobreath Regulator (11). The pressure should read 30 psi.

If necessary unlock the regulator by removing the wire tie and pressing up on the red ring. Adjust the knob until the pressure on the gauge reads 30 psi. Then lock the regulator by pressing down on the red ring. Secure the wire tie just above the red ring.

Remove the PSI Gauge Assembly.

Replace the orange plug line.

b. SWITCHPOINT

NOTE: *Perform step b.* ***only if*** *the Timing Variable Resistor (12) on the blue line has been replaced or its setting has become disturbed.*

Remove the orange plug line from the test port tee (13) on the blue capacitor line and connect the PSI Gauge Assembly at that point.

Clamp off the Inspiratory Check Valve (14).

Place the Autobreath On/Off Switch, on the Front Panel, in the *On* position.

Slightly turn the Breath Rate Control Knob, on the Front Panel, clockwise.

Observe the PSI Gauge Assembly. During inspiration the pressure should rise. During expiration the pressure should fall.

If necessary, adjust the Breath Rate Control Knob in order to read the high (Inspiratory) and low (Expiratory) points.

If the highest pressure point does not correspond to a 22 psi switchpoint, adjust the Timing Variable Resistor (12).

NOTE: *The low point is fixed and cannot be adjusted.*

Replace the orange plug assembly.

Remove the clamping device.

Place the Autobreath On/Off Switch, on the Front Panel, in the *Off* position.

Return the Breath Rate Control Knob to "18."

c. PILOT PRESSURE

Connect a patient circuit from the Exhalation Valve Port (17), Auxiliary Outlet (2) to the connector on the RT200 Tester or equivalent test device corresponding to the low pressure measurement.

At the Tester, select the test corresponding to a Low Pressure Range of 250 cm H_2O.

Remove the Auxiliary Relief Valve (3) and occlude the manifold with the Relief Valve Cap.

Set the Auxiliary Flow Control Knob, on the Front Panel, to 15 lpm.

Place the Autobreath On/Off Switch in the *On* position.

Place a clamping device on the blue capacitor line just ahead of test port tee (13) in order to lock the Unit into the Inspiratory mode.

Verify a reading of 60 cm H_2O, on the Tester.

In order to change the circuit pressure and obtain a reading of 60 cm H_2O, adjust the Pilot Pressure Variable Resistor (15) on the violet line.

Place the Autobreath On/Off Switch in the *Off* position.

Set the a Auxiliary Flow Control Knob to zero.

Remove the Relief Valve Cap.

Replace the Auxiliary Relief Valve.

Remove the clamping device.

Detach the patient circuit.

d. PEEP VALVE ZERO

Connect the Exhalation Valve Port (17) to the connector on the RT200 or equivalent test device corresponding to a low flow measurement.

At the Tester, select the test corresponding to a Low Flow Range of 5 lpm.

Clamp off the PEEP Variable Resistor (16) and the fixed resistor bleed on the yellow resistor bleed line.

Place the Autobreath On/Off Switch in the *On* position.

Place a clamping device on the blue capacitor line just ahead of test port tee (13) in order to lock the Unit into the Expiratory Mode.

Turn the PEEP Control Knob counter-clockwise until no flow is indicated on the Tester.

If necessary, loosen the setscrews securing the PEEP Control Valve (28), and position the Knob to the "min" position. Then retighten the setscrews.

Place the Autobreath On/Off Switch in the *Off* position.

Remove the clamping device.

Remove the hemostat.

Remove hose connections.

e. PEEP PRESSURE

Connect a patient circuit between the Patient Outlet Connector (9) and the Exhalation Valve Port (17).

Set the Patient Flow Rate, Patient Airway Pressure Relief Valve, and PEEP Valve to their maximum settings.

Place the Autobreath On/Off Switch in the *On* position.

As the Unit cycles, observe the Patient Pressure Gauge.

If necessary, adjust the PEEP Variable Resistor (16) for a pressure of 21 cm H_2O of PEEP.

Turn the Autobreath *Off*.

Return the Flow Control Knob, Airway Pressure Relief Control Knob and PEEP Control Knob to their minimum settings.

Remove the patient circuit.

f. BREATH RATE

Connect the Exhalation Valve Port (17) to the Transducer Set-Up.

Connect the Transducer Set-Up to the Digital Counter.

Clamp off the Inspiratory Check Valve (14).

Place the Autobreath On/Off Switch in the *On* position.

Monitor the pressure signal voltage to the counter that is created by the pressure signal from the Exhalation Valve Port.

NOTE: *1/2 peak voltage will be the trigger level for the counter.*

If required, set this as the trigger on the Counter.

NOTE: *Triggering on the rising voltage will measure Inspiratory time and on the falling voltage, Expiratory time.*

Adjust the Breath Rate Control Knob, on the Front Panel, for an Expiratory time of '2.222' seconds as indicated by the counter. The Breath Rate Control Knob should be set to 18 BPM.

If necessary, loosen the setscrews securing the Breath Rate Control Valve (27) and position the Breath Rate Control Knob to 18 BPM. Then retighten the setscrews.

Set the Breath Rate Control Knob to 60 BPM and verify that the Inspiratory time is '.333' seconds.

If necessary, adjust the Timing Variable Resistor (12).

Verify that the Expiratory time is '.666' seconds.

If necessary, adjust the Expiratory Resistor (18) .

Return the Breath Rate Control Knob to 18 BPM.

Check the Expiratory time again and readjust the Breath Rate Control Knob, if necessary.

Remove the clamping device from the Inspiratory Check Valve and adjust the Check Valve Resistor (19) for an Inspiratory time of '1.111' sec.

Continue to work with the knob positions until all rates and I:E ratios are within specification.

NOTE: *The times mentioned in the above step are for perfect rates without tolerance allowances. When calibrating the AutoBreath times, for best results throughout the full range of the rate setting, the times for 18 BPM and 60 BPM should be reduced by approximately 5%. The reduction will vary from unit to unit.*

- *The Breath Rate Knob has a greater effect at longer rates.*

  The Expiratory Resistor (18) has a greater effect on shorter Expiratory times.

  The Inspiratory Check Valve Resistor (19) has a greater effect on longer Inspiratory times. Use the Timing Resistor (12) to adjust for short Inspiratory times.

Place the Autobreath On/Off Switch in the *Off* position.

Return the Breath Rate Control Valve to 18 BPM.

Disconnect the Transducer Set-Up and Digital Counter.

The Autobreath Calibration is complete.

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